
CLAIMS

[Claim(s)]
[Claim 1] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of said double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is inputted from said double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of said subcarrier separated the component of said main carrier from the fixed optical frequency concerned further in the location of said fixed optical frequency. The optical filter section which passes the lightwave signal containing the component of either said top sideband wave and a lower side band out of said double modulation lightwave signal inputted from said double modulation section, By carrying out photoelectricity conversion of said lightwave signal inputted from said optical filter section Have further the photoelectricity converter which acquires said electrical signal which should be transmitted, and said optical sending set contains said double modulation section at least. It is the optical transmitter-receiver which said optical receiving set contains said photoelectricity converter at least, and is characterized by containing said optical filter section in either the optical sending set concerned and the optical receiving set concerned.
[Claim 2] Said double modulation section is an optical transmitter-receiver containing at least one external light modulation section which carries out amplitude modulation of said main carrier inputted from said semiconductor laser by the external light modulation method to the semiconductor laser which outputs said main carrier by the subcarrier by which amplitude modulation was carried out with the electrical signal into which it is inputted from the outside, and which should be transmitted according to claim 1.
[Claim 3] The optical transmitter-receiver according to claim 2 which the subcarrier by which amplitude modulation was carried out with said electrical signal which should be transmitted is the signal by which a radio transmission is carried out from the outside, receives said signal by which a radio transmission is carried out, and is further equipped with the antenna section supplied to said double modulation section.
[Claim 4] The optical transmitter-receiver according to claim 3 with which said electrical signal which should be transmitted is a multi-channel signal by which frequency multiplexing was carried out, and the subcarrier by which amplitude modulation was carried out by said multi-channel signal is characterized by being inputted into said double modulation section from the exterior.
[Claim 5] Said electrical signal which should be transmitted is an optical transmitter-receiver according to claim 3 with which it is digital information and said subcarrier by which on-off keying was carried out by said digital information is characterized by being inputted into said double modulation section from the exterior.
[Claim 6] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of said double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is

inputted from said double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of said subcarrier separated the component of said main carrier from the fixed optical frequency concerned further in the location of said fixed optical frequency. The optical filter section which passes the lightwave signal containing the component of either said top sideband wave and a lower side band out of said double modulation lightwave signal inputted from said double modulation section, By carrying out photoelectricity conversion of said 1st lightwave signal inputted from the optical tee which branches and outputs the lightwave signal inputted from said optical filter section to the 1st lightwave signal and the 2nd lightwave signal, and said optical tee With a predetermined time interval with the 1st photoelectricity converter which acquires said electrical signal which should be transmitted, and the 2nd photoelectricity converter which outputs the electrical signal acquired by carrying out photoelectricity conversion of said 2nd lightwave signal inputted from said optical tee as a signal for detection The average of the signal for detection inputted from said 2nd photoelectricity converter is detected. Based on the maximum of the detected average, it has further the wavelength control section which controls the wavelength of the double modulation lightwave signal outputted from said double modulation section. It is the optical transmitter-receiver which said optical sending set contains said double modulation section at least, and said optical receiving set contains said 1st photoelectricity converter at least, and is characterized by containing said optical filter section in either the optical sending set concerned and the optical receiving set concerned.
[Claim 7] It is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission]. Said optical sending set By becoming irregular to a duplex by the local oscillation section which outputs the subcarrier of constant frequency, the electrical signal into which the main carrier which is a light which has fixed optical frequency non-become irregular is inputted from the outside and which should be transmitted, and said subcarrier inputted from said local oscillation section The spectrum of said double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is outputted from said double modulation section The component of an upside wave and a lower side band is included in the location where only the frequency of said subcarrier separated the component of said main carrier from the fixed optical frequency concerned further in the location of said fixed optical frequency. The 1st lightwave signal which includes said double modulation lightwave signal into which said optical sending set is inputted from said double modulation section for the component of either said top sideband wave and a lower side band, It divides into the 2nd lightwave signal which contains any of said top sideband wave and a lower side band, or the component of another side in the component list of said main carrier. It has further the optical filter section which outputs the 1st lightwave signal and the 2nd lightwave signal concerned. Said 1st light receiving set To acquiring said electrical signal which should be transmitted by carrying out photoelectricity conversion of said 1st lightwave signal transmitted from said optical sending set, and a pan, said 2nd light receiving set The optical transmitter-receiver characterized by acquiring the signal by which said subcarrier was modulated with said electrical signal which should be transmitted by carrying out photoelectricity conversion of said 2nd lightwave signal transmitted from said optical sending set.
[Claim 8] The optical circulator section which outputs said double modulation lightwave signal into which said optical filter section is inputted from said double modulation section as it is, The inside of said double modulation lightwave signal inputted from said optical circulator section, By reflecting the component of either said top sideband wave and a lower side band, generate said 1st lightwave signal and it outputs to said optical circulator section. And the optical fiber grating section which generates said 2nd lightwave signal and is outputted to the 2nd light receiving set by penetrating any of the top sideband wave concerned and a lower side band or the component of another side in the component list of said main carrier is included. Said optical circulator section is an optical transmitter-receiver according to claim 7 which outputs further said 1st lightwave signal inputted from said optical fiber grating section as it is to the 1st light receiving set.
[Claim 9] Said 2nd light receiving set is an optical transmitter-receiver [equipped with the antenna section for emitting the signal which modulated the subcarrier with said acquired electrical signal which carried out photoelectricity conversion, and which should be transmitted to space] according to claim 7.
[Claim 10] Said electrical signal which should be transmitted is an optical transmitter-receiver according to claim 7 characterized by changing analog information into digital information.

[Claim 11] Said electrical signal which should be transmitted is an optical transmitter-receiver according to claim 7 characterized by carrying out multiplex [of the electrical signal which modulated the subcarrier of said intermediate frequency by analog information or digital information] by plurality and the predetermined multiplex system.
[Claim 12] Said predetermined multiplex system is an optical transmitter-receiver according to claim 11 which is Frequency-Division-Multiplexing connection, Time-Division-Multiplexing connection, or code division multiple access.
[Claim 13] It is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission]. Said optical sending set By becoming irregular to a duplex by the local oscillation section which outputs the subcarrier of constant frequency, the electrical signal into which the main carrier which is a light which has fixed optical frequency non-become irregular is inputted from the outside and which should be transmitted, and said subcarrier inputted from said local oscillation section It has the double modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs said double modulation lightwave signal inputted from said double modulation section. Said 1st light receiving set By passing the component contained in low-pass [of the electrical signal acquired by carrying out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set] It has the low pass filter section which outputs said electrical signal which should be transmitted. Said 2nd light receiving set The optical transmitter-receiver which is made to pass the component contained in the high region of the electrical signal acquired by carrying out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set, and is equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted.
[Claim 14] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. Said optical sending set By becoming irregular to a duplex by the local oscillation section which outputs the subcarrier of constant frequency, the electrical signal into which the main carrier which is a light which has fixed optical frequency non-become irregular is inputted from the outside and which should be transmitted, and said subcarrier inputted from said local oscillation section It has the double modulation section which generates and outputs a double modulation lightwave signal. Said optical receiving set The photoelectricity converter which carries out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from said photoelectricity converter for 2 minutes, and said distribution section] An optical transmitter-receiver equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs said electrical signal which should be transmitted, and said distribution section.
[Claim 15] Said double modulation section is said electrical signal which is inputted from the outside and which should be transmitted. By carrying out amplitude modulation of said subcarrier inputted from said local oscillation section With said modulation electrical signal inputted as the electric modulation section which generates and outputs a modulation electrical signal, and the light source which outputs said main carrier which is a light which has fixed optical frequency non-become irregular from said electric modulation section The optical transmitter-receiver containing the external light modulation section which generates said double modulation lightwave signal by carrying out amplitude modulation of said main carrier inputted from said light source according to claim 7, 13, or 14.
[Claim 16] It is the optical transmitter-receiver according to claim 15 with which said electrical signal which should be transmitted is digital information, and said electric modulation section carries out on-off keying of said subcarrier by said digital information.
[Claim 17] Said double modulation sections are the light source which outputs said main carrier which is a light which has fixed optical frequency non-become irregular, and said subcarrier inputted from said local oscillation section. With said electrical signal which is inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of said main carrier inputted from said light source, and the outside and which should be transmitted The

optical transmitter-receiver containing the 2nd external light modulation section which generates said double modulation lightwave signal by carrying out amplitude modulation of said modulation lightwave signal inputted from said 1st external light modulation section according to claim 7, 13, or 14.
[Claim 18] Said double modulation sections are the light source which outputs said main carrier which is a light which has fixed optical frequency non-become irregular, and said electrical signal which is inputted from the outside and which should be transmitted. By said subcarrier inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of said main carrier inputted from said light source, and said local oscillation section The optical transmitter-receiver containing the 2nd external light modulation section which generates said double modulation lightwave signal by carrying out amplitude modulation of said modulation lightwave signal inputted from said 1st external light modulation section according to claim 7, 13, or 14.
[Claim 19] Said double modulation section is an optical transmitter-receiver according to claim 13 or 14 characterized by modulating said main carrier with single side band amplitude modulation by said subcarrier into which it is inputted from said local oscillation section.
[Claim 20] It is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission]. Said optical sending set By carrying out mode locking based on the subcarrier inputted from the local oscillation section which outputs the subcarrier of constant frequency, and said local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted By carrying out amplitude modulation of said mode locking lightwave signal inputted from said mode locking light source It has the external light modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs said double modulation lightwave signal inputted from said external light modulation section. Said 1st light receiving set By passing the component contained in low-pass [of the electrical signal acquired by carrying out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set] It has the low pass filter section which outputs said electrical signal which should be transmitted. Said 2nd light receiving set An optical transmitter-receiver equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal acquired by carrying out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set.
[Claim 21] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. Said optical sending set By carrying out mode locking based on the subcarrier inputted from the local oscillation section which outputs the subcarrier of constant frequency, and said local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted It has the external light modulation section which generates and outputs a double modulation lightwave signal by carrying out amplitude modulation of said mode locking lightwave signal inputted from said mode locking light source. Said optical receiving set The photoelectricity converter which carries out photoelectricity conversion of said double modulation lightwave signal transmitted from said optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from said photoelectricity converter for 2 minutes, and said distribution section] An optical transmitter-receiver equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs said electrical signal which should be transmitted, and said distribution section.
[Claim 22] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. Said optical sending set With the 1st light source which outputs the 1st nothing modulation light which has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted By carrying out amplitude modulation of the 1st nothing modulation light inputted from said 1st light source The external light modulation section

which generates and outputs a modulation lightwave signal, and the 2nd light source which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from said 1st optical frequency, The modulation lightwave signal inputted from said external light modulation section, and the 2nd nothing modulation light inputted from said 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement It has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from said optical multiplexing section. Said 1st light receiving set By passing the component contained in low-pass [of the electrical signal acquired by carrying out photoelectricity conversion of said lightwave signal transmitted from said optical sending set] It has the low pass filter section which outputs said electrical signal which should be transmitted. Said 2nd light receiving set An optical transmitter-receiver equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal acquired by carrying out photoelectricity conversion of said lightwave signal transmitted from said optical sending set.
[Claim 23] It is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. Said optical sending set With the 1st light source which outputs the 1st nothing modulation light which has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted By carrying out amplitude modulation of the 1st nothing modulation light inputted from said 1st light source The external light modulation section which generates and outputs a modulation lightwave signal, and the 2nd light source which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from said 1st optical frequency, The modulation lightwave signal inputted from said external light modulation section, and the 2nd nothing modulation light inputted from said 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement It has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from said optical multiplexing section. Said optical receiving set The photoelectricity converter which carries out photoelectricity conversion of said lightwave signal transmitted from said optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from said photoelectricity converter for 2 minutes, and said distribution section] An optical transmitter-receiver equipped with the high pass filter section which outputs the signal which modulated said subcarrier with said electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs said electrical signal which should be transmitted, and said distribution section.
[Claim 24] Claims 13 and 14 characterized by installing the antenna section for emitting to space the signal which modulated the subcarrier with said electrical signal which is outputted from the high pass filter section concerned, and which should be transmitted in the latter part of said high pass filter section, and an optical transmitter-receiver given in either 20-23.
[Claim 25] Said electrical signal which should be transmitted is claims 7, 13, and 14 characterized by modulating the subcarrier of an intermediate frequency which has a frequency lower than the subcarrier outputted from said local oscillation section by analog information or digital information, and an optical transmitter-receiver given in either 20-23.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] More specifically, this invention relates to the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission] about an optical transmitter-receiver.
[0002]
[Description of the Prior Art] The optical transmission which puts and transmits information to light is expected if it is widely used for a future high-throughput telecom network from low loss and broadband nature. For example, the optical transmitter-receiver (the 1st light transmitter-receiver is called hereafter) for carrying out optical transmission of the electric high frequency signal, the optical transmitter-receiver (the 2nd light transmitter-receiver is called hereafter) for carrying out optical transmission of the baseband signaling, etc. are proposed. Hereafter, these two optical transmitter-receivers are concretely explained with reference to a drawing.
[0003] First, the 1st optical transmitter-receiver is explained. recent years, a cellular phone, or PHS (Personal Handyphone System) etc. -- wireless service is expanded quickly. Therefore, utilization of a still higher frequency is considered and the microcell system or pico cel system using the millimeter wave band which is 30GHz - 300GHz in general is being examined. In this cel system, the high frequency signal of a millimeter wave band is emitted from the base transceiver station of a large number connected with the control station, and wireless service is offered. This cel system has various advantages. Since the signal of a millimeter wave band has the large propagation loss in space, it cannot have an adverse effect on the 1st easily to an adjacent cel. Moreover, since the signal of a millimeter wave band is short wavelength, the antenna installed at a control station etc. is miniaturized by the 2nd. Furthermore, to the 3rd, since the signal of a millimeter wave band is a RF, it can take large transmission capacity. By this, implementation may be able to offer a difficult high-speed transport service with the conventional wireless service.
[0004] However, in the radio communications system which applied this cel system, many base transceiver stations are installed in the streets. Therefore, it is required that a base transceiver station should be small and cheap. So, the 1st optical transmitter-receiver which adopted the so-called subcarrier optical transmission method with which research and development are performed briskly in recent years may be applied to a radio communications system. In addition, it is related with a subcarrier optical transmission method, and is "Microwave and millimeter-wave fiber optic technologies for subcarrier transmission systems" (Hiroyo Ogawa, IEICE Transactions on Communications, Vol.E76-B, No.9, pp 1078-1090, September, and 1993), for example. It is described in detail. By this subcarrier optical transmission method, with the modulating signal which puts the information on a sound signal and/or a video signal on a subcarrier, and is acquired, the reinforcement of the main carrier which is a light non-become irregular typically is modulated, and a lightwave signal is acquired by this. Change of the reinforcement which this lightwave signal has is equivalent to change of the amplitude which a modulating signal has, change of a frequency, or change of a phase at a meaning. Since the optical fiber of low loss is used dramatically, when the above-mentioned modulating signal is a millimeter wave band, with a gestalt as it is, the modulating signal concerned is transmitted to a remote place, and sells at a subcarrier optical transmission method.
[0005] Here, drawing 17 is the block diagram showing the configuration of the typical 1st light transmitter-receiver. The 1st light transmitter-receiver is equipped with the light source 110, the external light

modulation section 120, an optical fiber 140, the photoelectricity converter 150, the frequency-conversion section 1710, and the recovery section 1720 in drawing 17 . Moreover, the light source 110 and the external light modulation section 120 constitute the optical sending set 101, and the photoelectricity converter 150, the frequency-conversion section 1710, and the recovery section 1720 constitute the optical receiving set 102 in a base transceiver station, and are installed in it by the control station again. However, in drawing 17 , the configuration only about the signal path of a uni directional, i.e., the configuration only about the signal path transmitted to a control station from a base transceiver station, is shown. electric modulating signal Smod of the millimeter wave band with which the electrical signal which should be transmitted to a control station from a base transceiver station put baseband signaling, such as a sound signal and/or a video signal, on the subcarrier typically in this 1st light transmitter-receiver it is . This electric modulating signal Smod It is inputted into the external light modulation section 120 of the optical sending set 101 through an antenna or amplifier (not shown) from a cellular phone, a PHS terminal, etc. which move in the exterior of a base transceiver station. Moreover, the light source 110 oscillates a light non-become irregular as a main carrier MC, and the main carrier MC concerned is inputted into the external light modulation section 120. The external light modulation section 120 is the electric modulating signal Smod into which extraneous light intensity modulation was carried out and the reinforcement of the inputted main carrier MC was inputted. Based on change of the amplitude which it has, it becomes irregular, and is a lightwave signal OSmod by this. It is obtained. This lightwave signal OSmod by which outgoing radiation is carried out to an optical fiber 140 from the external light modulation section 120 Itself becomes a subcarrier and it is the electric modulating signal Smod. Incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102, conveying the inside of an optical fiber 140 with a gestalt as it is. This photoelectricity converter 150 is the lightwave signal OSmod by which incidence was carried out by performing photoelectricity conversion. It changes into the electrical signal containing a part for that on-the-strength strange preparation. The frequency-conversion section 1710 carries out the down convert of the electrical signal inputted from the photoelectricity converter 150 at the electrical signal of an intermediate frequency band. The recovery section 1720 restores to the information on baseband signaling, such as a sound signal and/or a video signal, based on the electrical signal of the intermediate frequency band inputted from the frequency-conversion section 1710.

[0006] Next, the 2nd optical transmitter-receiver which carries out optical transmission of the baseband signaling is explained. Drawing 18 is the block diagram showing the configuration of the 2nd typical optical transmitter-receiver. The 2nd light transmitter-receiver is equipped with the light source actuator 1810, the light source 110, an optical fiber 140, and the photoelectricity converter 150 in drawing 18 . The light source actuator 1810 and the light source 110 constitute the optical sending set 101 among them, and the photoelectricity converter 150 constitutes the optical receiving set 102. In this 2nd light transmitter-receiver, the baseband signaling SBB which should be transmitted to the optical receiving set 102 from the optical sending set 101 is assumed to be digital information, such as a sound signal and/or a video signal. Baseband signaling SBB is inputted into the light source actuator 1810. The light source actuator 1810 drives the light source 110, and it becomes irregular based on the baseband signaling SBB into which the reinforcement which the lightwave signal outputted from the light source 110 concerned has was inputted (direct light modulation method). After this lightwave signal is transmitted in the inside of an optical fiber 140, photoelectricity conversion is carried out by the photoelectricity converter 150, and the original baseband signaling SBB is acquired by this. such an optical transmission technique is common, for example, was published in Showa 55 -- "-- an optical-communication technique -- a reader -- " (edited by Shimada, Ohm-Sha publication) -- the 2nd -- a chapter "optical transmission system -- actually -- " -- it is described.

[0007] However, photoelectricity conversion and in order to have to carry out frequency conversion, broadband nature is required of the photoelectricity converter 150 and the frequency-conversion section 1710 which are shown in drawing 17 for the RF signal of a millimeter wave band at accuracy. Otherwise, the recovery section 1720 cannot perform exact recovery processing. Therefore, within the 1st light transmitter-receiver, the electrical parts corresponding to a RF band will be connected. For this connection, the connector, waveguide, or semi rigid cable of dedication is used. Since a waveguide and a semi rigid cable were difficult to process it freely, they had the trouble [transmitter-receiver / 1st / optical] that manufacture was difficult. Moreover, when it was going to transmit the electrical signal of a RF like a millimeter wave band to low loss, the activity of a waveguide was needed, but since it was large

compared with a coaxial cable, the magnitude of the waveguide concerned had the trouble that the magnitude of the 1st transmitter-receiver will become large.
[0008]
[Problem(s) to be Solved by the Invention] As mentioned above, the 2nd light transmitter-receiver (refer to drawing 18) is well used, in order to transmit the baseband signaling SBB of digital information with a cable. On the other hand, it is examined that the 1st light transmitter-receiver (refer to drawing 17) is applied to a radio communications system. Thus, since applications differ mutually, the 1st and 2nd light transmitter-receiver is examined as a separate system, and the optical transmitter-receiver which carries out optical transmission of both baseband signaling and the electrical signal of a RF simultaneously was not examined so much. However, if a wavelength multiplexing technique is used, this optical transmitter-receiver can be built. That is, in a transmitting side, wavelength multiplexing of the lightwave signal outputted from the light source 110 of drawing 18 and the lightwave signal outputted from the external light modulation section 120 of drawing 17 is carried out. After the wavelength multiple signal acquired by this is transmitted in the inside of an optical fiber 140 and dissociating by the optical receiving side, photoelectricity conversion is carried out separately and, as for a receiving side, both signals are simultaneously acquired by this. However, since the transmitting side needed two or more light sources 110 from which oscillation wavelength differs mutually in order to have to separate the lightwave signal by which wavelength multiplexing was carried out to accuracy by the optical receiving side, the optical transmitter-receiver which applied the wavelength multiplexing technique had the trouble of requiring considerable cost in construction of the optical transmitter-receiver concerned.
[0009] In addition, the optical transmitter-receiver with which the subcarrier multiplex optical transmission method was applied is indicated by U.S. Pat. No. 5,596,436, and there is a part which resembles apparently some optical transmitter-receivers indicated to this application in it. However, in the optical transmitter-receiver concerning this United States patent, first, each baseband signaling is modulated for each subcarrier, and each electric modulating signal is generated by each mixer. By the combiner 40, a multiplexed signal multiplexes each electric modulating signal, and is generated. The external optical modulator 46 is this multiplexed signal, and is modulating a light from laser 44 non-become irregular. The optical sending set concerning such an above-mentioned United States patent is different from the optical sending set 101 of this application in respect of a configuration. That is, although the subcarrier used in the optical sending set 101 of this application is one wave, two or more subcarriers are used for the optical sending set concerning the above-mentioned United States patent. Therefore, the spectrum of the lightwave signal by which outgoing radiation is carried out from both optical sending sets is mutually different, and in the lightwave signal concerning the above-mentioned United States patent, although the component of a main carrier and the component of each subcarrier approach mutually on an optical frequency shaft, in the lightwave signal OS concerning this application (after-mentioned), the component of a main carrier and the component of a double sideband do not approach. By this, easy and the remarkable technical effectiveness that it can take out to accuracy also do the component of baseband signaling SBB so as compared with what the optical receiving set concerning this application requires for the above-mentioned United States patent.
[0010] So, the object of this invention is the optical transmitter-receiver which can carry out optical transmission of the electric RF signal, and is offering an optical transmitter-receiver with the small magnitude with the easy and manufacture moreover. Moreover, other objects of this invention are offering the optical transmitter-receiver which can carry out optical transmission of both baseband signaling and the RF signal simultaneously using the same light source.
[0011]
[The means for solving a technical problem and an effect of the invention] The 1st aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is inputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency

concerned further in the location of fixed optical frequency. By carrying out photoelectricity conversion of the lightwave signal inputted from the optical filter section which passes selectively the lightwave signal containing the component of either a top sideband wave and a lower side band out of the double modulation lightwave signal inputted from the double modulation section, and the optical filter section Have further the photoelectricity converter which acquires the electrical signal which should be transmitted, and the optical sending set contains the local oscillation section and the double modulation section at least. It is characterized by for the optical receiving set containing the photoelectricity converter at least, and containing the optical filter section in either the optical sending set concerned and the optical receiving set concerned. Since a photoelectricity converter can acquire directly the electrical signal which should transmit low frequency relatively from a lightwave signal according to the 1st aspect of affairs of the above, like the conventional subcarrier optical transmission, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. Furthermore, in connection with this, it becomes possible to constitute an optical receiving set from low cost simply.
[0012] The 2nd aspect of affairs contains at least one external light modulation section which carries out amplitude modulation of the main carrier inputted from semiconductor laser by the external light modulation method to the semiconductor laser to which the double modulation section outputs a main carrier by the subcarrier by which amplitude modulation was carried out with the electrical signal into which it is inputted from the outside, and which should be transmitted in the 1st aspect of affairs. According to the 2nd aspect of affairs of the above, when the double modulation section is constituted by existing semiconductor laser and the existing external light modulation section, an optical transmitter-receiver is built by low cost.
[0013] In the 2nd aspect of affairs, the 3rd aspect of affairs receives the signal with which the subcarrier by which amplitude modulation was carried out with the electrical signal which should be transmitted is the signal by which a radio transmission is carried out from the outside, and a radio transmission is carried out, and is further equipped with the antenna section supplied to the double modulation section. According to the 3rd aspect of affairs of the above, an optical transmitter-receiver is easily connected with a radio-transmission system by having the antenna section which receives the signal by which a radio transmission is carried out from the outside.
[0014] In the 3rd aspect of affairs, the electrical signal which should be transmitted is a multi-channel signal by which frequency multiplexing was carried out, the electric modulation section is a multi-channel signal, and the 4th aspect of affairs is characterized by generating and outputting a modulation electrical signal by carrying out amplitude modulation of the subcarrier inputted. An optical transmitter-receiver comes to be able to carry out optical transmission of much information according to the 4th aspect of affairs of the above.
[0015] The electrical signal which should transmit the 5th aspect of affairs in the 3rd aspect of affairs is digital information, and the electric modulation section carries out on-off keying of the subcarrier by digital information. According to the 5th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.
[0016] The 6th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is inputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency concerned further in the location of fixed optical frequency. The optical filter section which passes selectively the lightwave signal containing the component of either a top sideband wave and a lower side band out of the double modulation lightwave signal inputted from the double modulation section, By carrying out photoelectricity conversion of the 1st lightwave signal inputted from the optical tee which branches and outputs the lightwave signal inputted from the optical filter section to the 1st lightwave signal and the 2nd lightwave signal, and an optical tee With a predetermined time interval with the 1st photoelectricity converter which acquires the electrical signal which should be

transmitted, and the 2nd photoelectricity converter which outputs the electrical signal acquired by carrying out photoelectricity conversion of the 2nd lightwave signal inputted from an optical tee as a signal for detection Detect the average of the signal for detection inputted from the 2nd photoelectricity converter, and it is based on the maximum of the detected average. It has further the wavelength control section which controls the wavelength of the double modulation lightwave signal outputted from the double modulation section. It is characterized by for the optical sending set containing the local oscillation section and the double modulation section at least, and for the optical receiving set containing the 1st photoelectricity converter at least, and containing the optical filter section in either the optical sending set concerned and the optical receiving set concerned. According to the 6th aspect of affairs of the above, an optical transmitter-receiver consists of low cost simply like the 1st aspect of affairs, it being expensive and making [corresponded to the subcarrier band which is a RF relatively, and] the difficult electrical part of processing unnecessary. Furthermore, since the wavelength of a double modulation lightwave signal is controlled, the optical filter section can output the lightwave signal to which it can always restore to accuracy.

[0017] The local oscillation section to which the 7th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section The spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is outputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency concerned further in the location of fixed optical frequency. The 1st lightwave signal with which an optical sending set includes the double modulation lightwave signal inputted from the double modulation section for the component of either a top sideband wave and a lower side band, It divides into the 2nd lightwave signal which contains any of a top sideband wave and a lower side band, or the component of another side in the component list of a main carrier. When it has further the optical filter section which outputs the 1st lightwave signal and the 2nd lightwave signal concerned and the 1st light receiving set carries out photoelectricity conversion of the 1st lightwave signal transmitted from an optical sending set It is characterized by acquiring the signal which modulated the subcarrier with the electrical signal which should be transmitted acquiring the electrical signal which should be transmitted, and by carrying out photoelectricity conversion of the 2nd lightwave signal with which the 2nd light receiving set is further transmitted from an optical sending set. The 1st lightwave signal of the above is changed into the electrical signal which should be transmitted, when the component of a sideband wave is included and photoelectricity conversion is carried out by the above-mentioned 1st photoelectricity converter, while the double modulation lightwave signal by which double modulation was carried out [above-mentioned] contains. Moreover, the 2nd lightwave signal of the above contains the component of the sideband wave of another side of the double modulation lightwave signal by which double modulation was carried out [above-mentioned], and a main carrier, and when photoelectricity conversion is carried out by the above-mentioned 2nd photoelectricity converter, it is changed into the signal which modulated the subcarrier with the electrical signal which should be transmitted. Thus, according to the 7th aspect of affairs of the above, by the receiving side, both signal which modulated the subcarrier by the electrical signal and this which should be transmitted can be acquired simultaneously. Furthermore, since both signals can be transmitted by non-become irregular light 1 wave so that clearly if the above is referred to, two or more light sources are not needed like a wavelength multiplexing technique, but according to the 7th aspect of affairs of the above, an optical transmitter-receiver can be built by low cost.

[0018] The optical circulator section to which the 8th aspect of affairs outputs the double modulation lightwave signal into which the optical filter section is inputted from the double modulation section as it is in the 7th aspect of affairs, By reflecting the component of either a top sideband wave and a lower side band among the double modulation lightwave signals inputted from the optical circulator section, generate the 1st lightwave signal and it outputs to the optical circulator section. And the optical fiber grating section which generates the 2nd lightwave signal and is outputted to the 2nd light receiving set by penetrating any

of the top sideband wave concerned and a lower side band or the component of another side in the component list of a main carrier is included. The optical circulator section outputs further the 1st lightwave signal inputted from the optical fiber grating section as it is to the 1st light receiving set. On the 8th aspect of affairs of the above, since the optical filter section consists of the optical circulators and optical fiber gratings which are the existing optical components, an optical transmitter-receiver consists of low cost simply.

[0019] The 9th aspect of affairs is equipped with the antenna section for the 2nd light receiving set to emit the signal which modulated the subcarrier with the acquired electrical signal which carried out photoelectricity conversion, and which should be transmitted to space in the 7th aspect of affairs. The subcarrier modulated with the above-mentioned electrical signal which should carry out transmission is a suitable signal for a radio transmission. Then, according to the 9th aspect of affairs, an optical transmitter-receiver is easily connected with a radio-transmission system by having the antenna section in which the 2nd light receiving set emits this subcarrier to space.

[0020] The electrical signal which should transmit the 10th aspect of affairs in the 7th aspect of affairs is characterized by being changed into digital information by analog information. According to the 10th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.

[0021] The 11th aspect of affairs is characterized by carrying out multiplex [of the electrical signal with which the electrical signal which should be transmitted modulated the subcarrier of an intermediate frequency by analog information or digital information] by plurality and the predetermined multiplex system in the 7th aspect of affairs. In the 11th aspect of affairs, the predetermined multiplex system of the 12th aspect of affairs is Frequency-Division-Multiplexing connection, Time-Division-Multiplexing connection, or code division multiple access. An optical transmitter-receiver carries out multiplex [of much information], and comes to be able to carry out optical transmission of it according to the 11th and 12th aspects of affairs of the above.

[0022] The local oscillation section to which the 13th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section It has the double modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs the double modulation lightwave signal inputted from the double modulation section. By passing the component contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set] It has the low pass filter section which outputs the electrical signal which should be transmitted. The 2nd light receiving set The component contained in the high region of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set is passed, and it has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted. The receiving side of the 13th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.

[0023] The local oscillation section to which the 14th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section The photoelectricity converter which it has the double modulation section which generates and outputs a double modulation lightwave signal, and an optical receiving set carries out photoelectricity conversion of the double modulation lightwave signal transmitted

from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. The receiving side of the 14th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.
[0024] The 15th aspect of affairs is the electrical signal into which the double modulation section is inputted from the outside in the 7th, 13th, or 14th aspect of affairs and which should be transmitted. With the modulation electrical signal inputted as the electric modulation section which generates and outputs a modulation electrical signal by carrying out amplitude modulation of the subcarrier inputted from the local oscillation section, and the light source which outputs the main carrier which is a light which has fixed optical frequency non-become irregular from the electric modulation section By carrying out amplitude modulation of the main carrier inputted from the light source, the external light modulation section which generates a double modulation lightwave signal is included. According to the 15th aspect of affairs of the above, in order to transmit simultaneously the signal which modulated the subcarrier by the electrical signal and this which should be transmitted to a receiving side, the same light source is used for an optical sending set. An optical transmitter-receiver is built by low cost by this.
[0025] The electrical signal which should transmit the 16th aspect of affairs in the 15th aspect of affairs is digital information, and the electric modulation section carries out on-off keying of the subcarrier by digital information. According to the 16th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.
[0026] The 17th aspect of affairs is the light source which outputs the main carrier whose double modulation section is a light which has fixed optical frequency non-become irregular in the 7th, 13th, or 14th aspect of affairs, and the subcarrier inputted from the local oscillation section. With the electrical signal which is inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the main carrier inputted from the light source, and the outside and which should be transmitted By carrying out amplitude modulation of the modulation lightwave signal inputted from the 1st external light modulation section, the 2nd external light modulation section which generates a double modulation lightwave signal is included.
[0027] The 18th aspect of affairs is the light source which outputs the main carrier whose double modulation section is a light which has fixed optical frequency non-become irregular in the 7th, 13th, or 14th aspect of affairs, and the electrical signal which is inputted from the outside and which should be transmitted. By the subcarrier inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the main carrier inputted from the light source, and the local oscillation section By carrying out amplitude modulation of the modulation lightwave signal inputted from the 1st external light modulation section, the 2nd external light modulation section which generates a double modulation lightwave signal is included. According to the above 17th and the aspect of affairs of 18, in order to transmit simultaneously the signal which modulated the subcarrier by the electrical signal and this which should be transmitted to a receiving side, the same light source is used for an optical sending set. An optical transmitter-receiver is built by low cost by this.
[0028] The 19th aspect of affairs is characterized by the double modulation section becoming irregular by the subcarrier into which a main carrier is inputted from the local oscillation section by single side band amplitude modulation in the 13th or 14th aspect of affairs. According to the 19th aspect of affairs of the above, by applying single side band amplitude modulation, a double modulation lightwave signal stops being influenced of wavelength dispersion easily in the optical fiber as an optical transmission line, and the transmission distance becomes long.

[0029] The local oscillation section to which the 20th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By carrying out mode locking based on the subcarrier inputted from the local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted By carrying out amplitude modulation of the mode locking lightwave signal inputted from the mode locking light source It has the external light modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs the double modulation lightwave signal inputted from the external light modulation section. By passing the component contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set] By having the low pass filter section which outputs the electrical signal which should be transmitted, and passing the component contained in the high region of the electrical signal acquired by the 2nd light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted. The receiving side of the 20th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.

[0030] The local oscillation section to which the 21st aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By carrying out mode locking based on the subcarrier inputted from the local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted By carrying out amplitude modulation of the mode locking lightwave signal inputted from the mode locking light source The photoelectricity converter which it has the external light modulation section which generates and outputs a double modulation lightwave signal, and an optical receiving set carries out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. The receiving side of the 21st aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.

[0031] The 22nd aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and is the 1st light source which outputs the 1st nothing modulation light in which an optical sending set has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted. The external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the 1st nothing modulation light inputted from the 1st light source, The 2nd light source

which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from the 1st optical frequency, The modulation lightwave signal inputted from the external light modulation section, and the 2nd nothing modulation light inputted from the 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement It has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from the optical multiplexing section. By passing the component contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the lightwave signal transmitted from an optical sending set] By having the low pass filter section which outputs the electrical signal which should be transmitted, and passing the component contained in the high region of the electrical signal acquired by the 2nd light receiving set carrying out photoelectricity conversion of the lightwave signal transmitted from an optical sending set It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted.
[0032] The 23rd aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and is the 1st light source which outputs the 1st nothing modulation light in which an optical sending set has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted. The external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the 1st nothing modulation light inputted from the 1st light source, The 2nd light source which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from the 1st optical frequency, The modulation lightwave signal inputted from the external light modulation section, and the 2nd nothing modulation light inputted from the 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement The photoelectricity converter which it has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from the optical multiplexing section, and an optical receiving set carries out photoelectricity conversion of the lightwave signal transmitted from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. According to the 22nd and 23rd aspects of affairs, a modulation lightwave signal is generated by carrying out amplitude modulation with the electrical signal which the 1st nothing modulation light should transmit. A lightwave signal is generated by being multiplexed with the 2nd nothing modulation light in this modulation lightwave signal. For example, although electric light conversion needed to be twice performed on the 7th aspect of affairs, the optical sending set of this aspect of affairs performs electric light conversion only once. Thus, low loss optical transmission is realizable by lessening the count of electric light conversion. Furthermore, the optical sending set of this aspect of affairs does not need the electrical part for carrying out amplitude modulation with the electrical signal which should transmit a subcarrier. That is, according to this aspect of affairs, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. In connection with this, it becomes possible to constitute an optical transmitter-receiver from low cost simply.
[0033] The 24th aspect of affairs is characterized by installing the antenna section for emitting to space the signal which modulated the subcarrier with the electrical signal which is outputted from the high pass filter section concerned, and which should be transmitted in the latter part of the high pass filter section in the 13th, the 14th and the 20th - the 23rd one of aspects of affairs. According to the 24th aspect of affairs of the above, an optical transmitter-receiver is simply connected with a radio-transmission system like the 13th aspect of affairs.
[0034] the 25th aspect of affairs -- the 7th, the 13th, the 14th, and the 20- the electrical signal which the 23rd should not be but should be transmitted in that aspect of affairs is characterized by modulating the

subcarrier of an intermediate frequency which has a frequency lower than the subcarrier outputted from the local oscillation section by analog information or digital information. When the electrical signals which should be transmitted are the above electrical signals, in the receiving side of the optical transmitter-receiver concerning the 25th aspect of affairs of the above, the subcarrier of the intermediate frequency modulated with the analog signal etc. and the signal which modulated the subcarrier now are acquired. By this, the optical transmission by the type of modulation of an optical transmitter-receiver becomes possible.
[0035]
[Embodiment of the Invention]
(1st operation gestalt) Drawing 1 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 1st operation gestalt of this invention. The optical sending set 101 and the optical receiving set 102 are connected to the optical transmitter-receiver shown in drawing 1 possible [optical transmission] through an optical fiber 140. The optical sending set 101 is equipped with the light source 110, the external light modulation section 120, the optical filter section 130, and the antenna section 190, and the optical receiving set 102 is equipped with the photoelectricity converter 150. Moreover, - (d-1) shows typically the spectrum of the signal in important section (a-1) - (d-1) of the optical transmitter-receiver shown in drawing 2 (a-1) and drawing 1 .
[0036] Hereafter, actuation of the optical transmitter-receiver shown in drawing 1 is explained based on drawing 1 and drawing 2 . It sets to the optical sending set 101, and is constant frequency f0 in the antenna section 190. The electric subcarrier SC is a frequency f1. The radio transmission of the signal (the modulation electrical signal Smod is called hereafter) by which amplitude modulation was carried out with the baseband signaling SBB which should be transmitted is carried out from the outside. The antenna section 190 is this modulation electrical signal Smod. It receives and outputs to the external light modulation section 120. Now, the current wave form of this baseband signaling SBB is set to I (t). Moreover, this amplitude modulation is a modulation factor md. Suppose that it is carried out. Then, this modulation electrical signal Smod Voltage waveform Vd (t) is expressed with a degree type (1).
Vd (t) =(1+md I (t)) cos (omega0 t) -- (1)
here -- omega0 =2pif0 it is . Moreover, when (1+md I(t)) is placed with D (t), a top type (1) is expressed with a degree type (2).
Vd (t) =D (t) cos (omega0 t) -- (2)
[0037] The light source 110 consists of semiconductor laser typically, oscillates a light of the fixed optical frequency nu as shown in drawing 2 (a-1) non-become irregular, and outputs this as a main carrier MC. The external light modulation section 120 is the modulation electrical signal Smod which has the configuration of for example, a Mach TSUENDA mold, and is inputted from the antenna section 190. Amplitude modulation of the main carrier MC inputted from the light source 110 is carried out, and the lightwave signal (the double modulation lightwave signal OSdmod is called hereafter) modulated by the duplex by this is generated. More specifically, the external light modulation section 120 of a Mach TSUENDA mold dichotomizes the inputted main carrier MC first. It is the modulation electrical signal Smod into which while branched and the main carrier MC was inputted. An optical phase modulation is carried out. It is multiplexed with the main carrier MC of branched another side in this main carrier MC by which the optical phase modulation was carried out, and the above-mentioned double modulation lightwave signal OSdmod is generated by this. Amplitude change of the double modulation lightwave signal OSdmod is the modulation electrical signal Smod. The optical spectrum is optical frequency nu to the optical frequency f0 further about the component of a main carrier MC to the main optical frequency nu, as amplitude change is supported at a meaning and it is shown in drawing 2 (b-1). It has the component of a sideband wave (a top sideband wave and lower side band) in the location (only for **f 0, a graphic display is) of an integral multiple. The occupancy frequency band of this double sideband component is the above-mentioned frequency f1. It depends.
[0038] Next, field strength wave [of this double modulation lightwave signal OSdmod] E (t) is mathematized. It is Vpi about the minimum value of the difference of input voltage in case the amplitude of the double modulation lightwave signal OSdmod outputted from the external light modulation section 120 serves as 0 and max. It carries out and it is assumed that the phase contrast between the main carrier MC it is multiplexed [main carrier] within the external light modulation section 120, and the main carrier MC by which the phase modulation was carried out is further set as pi/2. If this assumption is followed, the

double modulation lightwave signal OSdmod is expressed with a degree type (3).
[Equation 1]

$$E(t)=\frac{E}{2}\{\cos(2\pi\nu t)+\cos(2\pi\nu t)\cos(\delta_1)-\sin(2\pi\nu t)\sin(\delta_1)\}$$
$$=\frac{E}{2}\{\cos(2\pi\nu t)-\cos(kD(t)\cos(\omega_0 t)\sin(2\pi\nu t)$$
$$-\sin(kD(t)\cos(\omega_0 t))\cos(2\pi\nu t)\}\cdots(3)$$

however, k=pi/2Vpi it is -- delta 1 It is expressed with a degree type (4).
[Equation 2]

$$\delta_1=\frac{\pi D(t)\cos(\omega_0 t)}{2\quad V_\pi}+\frac{\pi}{2}\cdots(4)$$

For example, baseband signaling SBB is delta 1 when it assumes that it is a sine wave and the current wave form is expressed as I(t) =cos (omega1 t) (omega1 =2pif1). It is expressed with a degree type (5), and a top type (3) can be developed like a degree type (6), if a degree type (5) is used.
[Equation 3]

$$\delta_1=k(1+m_d\cos(\omega_1 t))\cos(\omega_0 t)+\frac{\pi}{2}\cdots(5)$$

[Equation 4]

$$E(t)=\frac{E}{2}\cos(2\pi\nu t)$$
$$-\frac{E}{2}\cos(k(1+m\cos(\omega_1 t))\cos(\omega_0 t))\cos(2\pi\nu t)$$
$$-\frac{E}{2}\sin(k(1+m\cos(\omega_1 t))\cos(\omega_0 t))\cos(2\pi\nu t)\cdots(6)$$

Moreover, it sets at a top ceremony (6) and is optical frequency nu, and the nu and f1 concerned. And f0 Consideration of even the primary term expresses field strength wave [of the double modulation lightwave signal OSdmod] E (t) with a degree type (7) eventually.
[Equation 5]

$$E(t)=\frac{E}{2}\cos(2\pi\nu t)$$
$$1+2J_1(k)J_0^2(\frac{km_d}{2})\cos(\omega_0 t)$$
$$-2J_0(k)J_0(\frac{km_d}{2})J_1(\frac{km_d}{2})(\cos(\omega_0+\omega_1)t+\cos(\omega_0-\omega_1)t)\cdots(7)$$

Here, it is J0. It is a zero-order Bessel function, and is J1. It is the primary Bessel function.
[0039] The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130. The passband of the optical filter section 130 is set up so that only the component of a top sideband wave or the component of a lower side band can be extracted among each component which the double modulation lightwave signal OSdmod shown in drawing 2 (b-1) has. For example, the passband of the optical filter section 130 is optical frequency nu+f 0. When set as near (refer to the part surrounded by the dotted line among drawing 2 (b-1)), only the component of a top sideband wave passes the optical filter section 130 concerned as a lightwave signal OS. The optical spectrum of this lightwave signal OS has only the same component as an above top sideband wave, as shown in drawing 2 (c-1), and it is optical frequency nu+f 0. It is contained in a nearby optical frequency band.
[0040] the field strength wave of this lightwave signal OS -- Ef (t) is expressed with a degree type (8). Moreover, filing of a degree type (8) obtains a degree type (9).
[Equation 6]

$$E_f(t)=\frac{E}{2}J_0(\frac{km_d}{2})$$
$$J_1(k)J_0(\frac{km_d}{2})\cos(\omega+\omega_0)t$$
$$-J_0(k)J_1(\frac{km_d}{2})(\cos(\omega+\omega_0+\omega_1)t+\cos(\omega+\omega_0-\omega_1)t)\cdots(8)$$

[Equation 7]
$$E_f(t) = K\cos(\omega + \omega_0)t(1 - m'\cos\omega_1 t) \cdots (9)$$

Here, in a top type (8) and (9), it is omega=2pinu, and m' is expressed with a degree type (10) in a top type (9), and K is expressed with a degree type (11).
[Equation 8]
$$m' = \frac{J_0(k)J_1(\frac{km_d}{2})}{J_1(k)J_0(\frac{km_d}{2})} \cdots (10)$$

[Equation 9]
$$K = \frac{E}{2}J_0(\frac{km_d}{2})J_1(k)J_0(\frac{km_d}{2}) \cdots (11)$$

[0041] Outgoing radiation is carried out to an optical fiber 140 from the optical filter section 130, the lightwave signal OS explained with reference to a formula and drawing 2 (c-1) above is transmitted with an optical fiber 140, and incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102. A lightwave signal OS will be transmitted to a remote place by this. This photoelectricity converter 150 performs photoelectricity conversion to the lightwave signal OS by which incidence was carried out, and outputs an electrical signal. This lightwave signal OS will be optical frequency nu+f 0, if drawing 2 (c-1) is referred to. It turns out that it is equivalent to that by which amplitude modulation was carried out with the baseband signaling SBB (=cos2pif1 t) whose subcarrier is the information which should be transmitted. Therefore, the current wave form Ipd of the electrical signal which the photoelectricity converter 150 outputs (t) is expressed with a degree type (12).
[Equation 10]
$$I_{pd}(t) = \frac{\eta}{2}K^2(1 - m'\cos\omega_1 t)^2$$
$$= I_{pd}(1 - 2m'\cos\omega_1 t + m'^2\cos^2\omega_1 t) \cdots (12)$$

However, eta is the conversion efficiency of the photoelectricity converter 150, and Ipd is a direct-current component. It is the output electrical signal of the photoelectricity converter 150 to omega 1 so that it may understand, if a top type (12) is referred to. If only a component (component of a frequency f1) is extracted, as shown in drawing 2 (d-1), the amplitude modulation component which a lightwave signal OS has, i.e., current wave form [of baseband signaling SBB] I, (t) will be obtained directly. In addition, omega 1 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only a component. Thus, the photoelectricity converter 150 is a frequency f1. Broadband nature like the usual subcarrier optical transmission is not required that what is necessary is just to have the frequency characteristics of a band.
[0042] In the above explanation, it was assumed that baseband signaling SBB is got blocked from a viewpoint of the simplification of explanation as it is I(t) =cos (omega1 t), and it was a signal of one channel. However, whether baseband signaling SBB is a signal of multi-channel or it is expressed I(t) =cos(omega1 t)+cos(omega2 t)+-- that is, in a **** transmitter-receiver, it can get over like the signal of one channel. Moreover, when especially the baseband signaling SBB is digital information, it is the modulation electrical signal Smod. The component of Subcarrier SC will be called ASK (Amplitude Shift Keying) and on-off keying (On Off Keying), digital amplitude modulation will be carried out, and a **** transmitter-receiver can carry out now optical transmission of the quality information by this.
[0043] Moreover, when both side-band modulation of the subcarrier SC is carried out with the baseband signaling SBB (=I (t)) of digital information, it is the modulation electrical signal Smod. Voltage waveform Vd (t) is expressed with a degree type (13).
[Equation 11]
$$V_d(t) = D(t)\cos(\omega_0 t) = m_d I(t)\cos(\omega_0 t) \cdots (13)$$

Moreover, field strength wave [of the double modulation lightwave signal OSdmod outputted from the external light modulation section 120] E (t) is called for like a degree type (14) at this time.
[Equation 12]

$$E(t) = \frac{E}{2}(\cos(\omega t) - J_0(k)\sin(\omega t))$$
$$+\frac{E}{2}J_1(k)\cos(\omega+\omega_0)t + \frac{E}{2}J_1(k)\cos(\omega-\omega_0)t \cdots (14)$$

After the double modulation lightwave signal OSdmod expressed with a top type (14) passing the optical filter section 130 and carrying out optical transmission of the optical fiber 140 as a lightwave signal OS, incidence of it is carried out to the photoelectricity converter 150. As mentioned above, the photoelectricity converter 150 performs photoelectricity conversion to the lightwave signal OS by which incidence was carried out, and outputs an electrical signal. The current wave form Ipd of an electrical signal (t) is expressed with a degree type (15).
[Equation 13]

$$I_{pd}(t) = \frac{\eta}{2}(\frac{E}{2}J_1(kmdI(t)))^2$$
$$\doteq \frac{\eta}{2}(\frac{E}{2}\frac{kmdI(t)}{2})^2 \cdots (15)$$

It is set to kmd I(t) <<1 in a top type (15). Thus, the output current wave of the photoelectricity converter 150 will be acquired as a recovery signal as it is so that clearly [in the case of both side-band modulation] also from a top type (15). Moreover, a top type (15) shows that Ipd (t) receives the secondary change to the primary change of I (t). Therefore, if M-ASK (multiplex ASK modulation technique) is adopted, since threshold spacing of Ipd (t) will double by the decibel compared with threshold spacing of I (t), it turns out that a lightwave signal OS becomes strong to a noise with a possibility of generating on an optical transmission line (optical fiber).
[0044] In addition, although the phase contrast between the main carrier MC it is multiplexed [main carrier] within the external light modulation section 120 here, and the main carrier by which the phase modulation was carried out was assumed to be pi/2, even when phase contrast is except pi/2, the same effectiveness is acquired fundamentally. Furthermore, the same effectiveness is acquired even when the external optical modulator of an electric-field absorption mold etc. is used instead of the external optical modulator of a Mach TSUENDA mold. As explained above, in addition to the electrical part (the down converter and demodulator of a millimeter wave band) of the required RF becoming unnecessary with the conventional optical transmitter-receiver, in a **** transmitter-receiver, RF components which are hard to deal with it, such as a waveguide and a semi rigid cable, become completely unnecessary by carrying out optical transmission of the electrical signal of a RF called a millimeter wave band, and carrying out optical signal processing to this lightwave signal by optical signal processing, further. This enables it to miniaturize the magnitude of an optical transmitter-receiver dramatically.
[0045] moreover, the optical spectrum shown in drawing 2 (b-1) in order to carry out external light modulation of the main carrier with the electrical signal of a RF called a millimeter wave band -- setting -- optical frequency spacing between a main carrier component and a sideband wave component -- being large (equivalent to a millimeter wave band) -- the optical filter section 130 can extract only a sideband wave component to accuracy with the present technique by this. In addition, at the 1st operation gestalt, the external light modulation section 120 is the electric modulating signal Smod of a millimeter wave band so that remarkable technical effectiveness may be done so. It is made to carry out light modulation of the main carrier MC. However, electric modulating signal Smod of the frequency band with the other external light modulation section 120 Even if it carries out light modulation, the optical receiving set 102 can restore to baseband signaling SBB, without needing an electrical part (a down converter and demodulator). That is, the optical transmitter-receiver concerning the 1st operation gestalt can be applied to a larger frequency band, without being restricted to a millimeter wave band.
[0046] Moreover, the optical transmitter-receiver concerning the 1st operation gestalt is the modulation electrical signal Smod which is a millimeter wave band. Since it was difficult when carrying out direct light modulation took into consideration the frequency response characteristic of the light source 110, the external light modulation method had been adopted. However, modulation electrical signal Smod If it is below a microwave band in general, it will not be concerned with the above-mentioned frequency response characteristic, but it is the modulation electrical signal Smod concerned. The direct drive of the light

source 110 can be carried out, and direct modulation of the output luminous intensity of the light source 110 concerned can also be carried out. That is, a direct light modulation method can also be used for a **** transmitter-receiver. Moreover, in the optical transmitter-receiver concerning the 1st operation gestalt, the optical filter section 130 of the optical sending set 101 extracted the lightwave signal OS from the double modulation signal OSdmod, and was carrying out outgoing radiation to the optical fiber 140. However, the optical receiving set 102 may be equipped with the optical filter section 130. In this case, the optical sending set 101 carries out outgoing radiation of the double modulation lightwave signal OSdmod generated in the external light modulation section 120 to the direct optical fiber 140. The optical receiving set 102 performs photoelectricity conversion to the extracted lightwave signal OS by the photoelectricity converter 150 currently postposed, after extracting a lightwave signal OS from the double modulation lightwave signal OSdmod by which incidence was carried out from the optical fiber 140 by the optical filter section 130 prefaced.

[0047] (2nd operation gestalt) Drawing 3 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 2nd operation gestalt of this invention. The optical sending set 101 and the optical receiving set 102 are connected to the optical transmitter-receiver shown in drawing 3 possible [optical transmission] through an optical fiber 140. The optical sending set 101 is equipped with the light source 110, the 1st and 2nd external light modulation section 120-1 and 120-2, the optical filter section 130, and the local oscillation section 170, and the optical receiving set 102 is equipped with the photoelectricity converter 150. - (b-3) shows typically the spectrum of the signal in important section (a-3) - (b-3) of the optical transmitter-receiver shown in drawing 4 (a-3) and drawing 3 .

[0048] Hereafter, actuation of the optical transmitter-receiver shown in drawing 3 is explained based on drawing 3 , drawing 4 , etc. In the optical sending set 101, the light source 110 consists of semiconductor laser typically, oscillates a light of the fixed optical frequency nu as shown in drawing 2 (a-1) non-become irregular, and outputs it to the 1st external light modulation section 120-1 by making this into a main carrier MC. Moreover, the local oscillation section 170 is the constant frequency f0 of a millimeter wave band. The electric subcarrier SC is outputted to the 1st external light modulation section 120-1. The 1st external light modulation section 120-1 has the configuration of for example, a Mach TSUENDA mold (refer to the 1st operation gestalt), and it carries out amplitude modulation by the subcarrier SC into which the inputted main carrier MC (refer to drawing 2 (a-1)) was inputted. By this, it is the modulation lightwave signal OSmod. It is generated and is outputted to the 2nd external light modulation section 120-2. This modulation lightwave signal OSmod It has the component of a main carrier MC in the main optical frequency nu, and optical spectrum has the component of a sideband wave (a top sideband wave and lower side band) further in the location (only for **f 0, a graphic display is) of the integral multiple of optical frequency nu to the optical frequency f0, as shown in drawing 4 (a-3).

[0049] Moreover, frequency f1 The baseband signaling SBB which should be transmitted is inputted into the 2nd external light modulation section 120-2 from the exterior of the optical sending set 101. It has the configuration of a Mach TSUENDA mold (refer to the 1st operation gestalt), and amplitude modulation also of the 2nd external light modulation section 120-2 is carried out with the baseband signaling SBB into which the inputted modulation lightwave signal OSmod (refer to drawing 4 (a-3)) was inputted. The double modulation lightwave signal OSdmod is generated by this. The optical spectrum of this double modulation lightwave signal OSdmod is optical frequency nu to the optical frequency f0 further about the component of a main carrier MC to the main optical frequency nu, as shown in drawing 4 (b-3). It has the component of a sideband wave (a top sideband wave and lower side band) in the location (only for **f 0, a graphic display is) of an integral multiple. Moreover, the occupancy frequency band of a double sideband component is a frequency f1. It depends. In addition, in drawing 4 (b-3), the component of baseband signaling SBB is the point generated also to a main carrier MC, and is different from what was shown in drawing 2 (b-1). The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130. In the optical transmitter-receiver shown in drawing 3 , the component after the optical filter section 130 performs the same actuation as the component which corresponds in the optical transmitter-receiver shown in drawing 1 . Therefore, suppose that explanation of the above-mentioned component which carries out an equivalent is omitted with the 2nd operation gestalt. However, since the modulation approach of the 2nd operation gestalt is different from the thing of the 1st operation gestalt, most formulas used with the 1st operation gestalt concerned expound on not being applied with the 2nd operation gestalt concerned.

[0050] In addition, in the optical transmitter-receiver shown in drawing 3 , it became irregular using Subcarrier SC and the 1st external light modulation section 120-1 was modulating the 2nd external light modulation section 120-2 using baseband signaling SBB. However, the 1st external light modulation section 120-1 may carry out amplitude modulation using baseband signaling SBB, and the 2nd external light modulation section 120-2 may carry out amplitude modulation using Subcarrier SC. Moreover, also with the optical transmitter-receiver concerning the 2nd operation gestalt, the optical filter section 130 of the optical sending set 101 extracted the lightwave signal OS from the double modulation signal OSdmod, and was carrying out outgoing radiation to the optical fiber 140. However, the optical receiving set 102 may be equipped with the optical filter section 130. In this case, the optical sending set 101 carries out outgoing radiation of the double modulation lightwave signal OSdmod generated in the 2nd external light modulation section 120-2 to the direct optical fiber 140. The optical receiving set 102 performs photoelectricity conversion to a lightwave signal OS by the postposed photoelectricity converter 150, after extracting a lightwave signal OS from the double modulation lightwave signal OSdmod by which incidence was carried out from the optical fiber 140 by the prefaced optical filter section 130.
[0051] (3rd operation gestalt) Drawing 5 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 3rd operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 5 , the optical receiving set 102 shown in drawing 1 or drawing 3 is connectable. The optical sending set 101 shown in drawing 5 is equipped with the local oscillation section 170, the mode locking light source 510, the external light modulation section 120, and the optical filter section 130.
[0052] Hereafter, the optical sending set 101 shown in drawing 5 is explained with reference to drawing 2 , drawing 4 , and drawing 5 . The local oscillation section 170 outputs the same subcarrier SC as ****. Mode locking of the mode locking light source 510 is carried out by the inputted subcarrier SC, and it carries out multimode oscillation. Which approach may be used for it although the approach of this mode locking has some which are depended on an electric drive or optical impregnation. It is the modulation lightwave signal OSmod shown in (a-3) of drawing 4 from the mode locking light source 510 when setting up spacing of the frequency which carries out mode locking equally to the frequency of Subcarrier SC here. The same lightwave signal (in accuracy, although it is oscillating in the many modes to the still larger optical frequency band, this lightwave signal is also called the modulation lightwave signal OSmod for convenience) is outputted to the external light modulation section 120. Moreover, the same baseband signaling SBB as **** is inputted into the external light modulation section 120 from the exterior of the optical sending set 101. The external light modulation section 120 is the inputted modulation lightwave signal OSmod. By carrying out amplitude modulation with the inputted baseband signaling SBB, the double modulation lightwave signal OSdmod shown in (b-5) of drawing 4 is generated and outputted. Although the double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130, since the component after the optical filter section 130 is the same as the component which corresponds in drawing 1 or drawing 3 as mentioned above, the explanation is omitted.
[0053] (4th operation gestalt) Drawing 6 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 4th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 6 is different at the point further equipped with the optical tee 310, the 2nd photoelectricity converter 320, and the wavelength control section 330 as compared with the optical transmitter-receiver shown in drawing 1 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is omitted. In addition, they are the 1st photoelectricity converter 150 and the 1st lightwave signal OS 1 so that the photoelectricity converter 150 shown in drawing 1 and the lightwave signal OS transmitted in an optical fiber 140 may be known with the expedient top [of explanation], and 4th [this] operation gestalt, if drawing 6 is referred to. It expounds on what is called here (refer to drawing 6).
[0054] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 4th operation gestalt hereafter to drawing 1 based on drawing 6 . In drawing 6 , as the 1st operation gestalt explained, a lightwave signal OS is outputted from the optical filter section 130, and is inputted into the optical tee 310. It is the 1st lightwave signal OS 1 about the lightwave signal OS into which the optical tee 310 was inputted. The 2nd lightwave signal OS 2 It dichotomizes and is the 1st lightwave signal OS 1. Outgoing radiation is carried out to an

optical fiber 140, and it is the 2nd lightwave signal OS 2. It outputs to the 2nd photoelectricity converter 320. This 1st lightwave signal OS 1 After transmitting an optical fiber 140, it is processed by the 1st photoelectricity converter 150 like explanation with the 1st operation gestalt. The 2nd lightwave signal OS 2 into which the 2nd photoelectricity converter 320 was also inputted It receives, photoelectricity conversion is performed and an electrical signal is outputted. It is the signal Sdet for detection about the following and this electrical signal. It calls.

[0055] The wavelength control section 330 is the signal Sdet for detection which is the time interval defined beforehand and is inputted. The average is detected. And the wavelength control section 330 is the maximum Vmax out of the detected average. It chooses and is the maximum Vmax concerned. To always be detected, the temperature or bias current of the light source 110 is controlled, and the wavelength (optical frequency) of a main carrier MC is controlled. In an optical transmitter-receiver, the oscillation wavelength of the light source 110 and/or the passband of the optical filter section 130 may shift from the oscillation wavelength defined beforehand and/or a passband by secular change or change of ambient temperature. When such a gap arises, it becomes impossible for the optical filter section 130 to extract only the component of a top sideband wave, or the component of a lower side band to accuracy out of each component (a main carrier component and double sideband component) which the double modulation lightwave signal OSdmod contains. However, since according to the optical transmitter-receiver concerning the 4th operation gestalt the wavelength control section 330 carries out the monitor of the lightwave signal OS and is carrying out feedback control of the oscillation wavelength of the light source 110, even if the above gaps arise, this can be amended and this can always extract [the optical filter section 130] only one sideband wave to accuracy.

[0056] (5th operation gestalt) Drawing 7 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 5th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 7 is different at the point further equipped with the 2nd light receiving set 102-2 connected with the optical sending set 101 possible [optical transmission] through the 2nd optical fiber 140-2 in profile as compared with the optical transmitter-receiver shown in drawing 1 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is simplified. In addition, the lightwave signal OS the optical fiber 140 shown in drawing 1 , the optical receiving set 102, and the photoelectricity converter 150 were indicated to be to drawing 1 again in the thing of explanation called for convenience the 1st optical fiber 140-1, the 1st light receiving set 102-1, and the 1st photoelectricity converter 150-1 with the 5th operation gestalt is the 1st lightwave signal OS 1. It expounds on what is called here. Moreover, the optical sending set 101 shown in drawing 7 is replaced with the optical filter section 130 as compared with the optical sending set 101 shown in drawing 1 , and is different at a point equipped with the optical filter section 710. Furthermore, the 2nd light receiving set 102-2 is equipped with the 2nd photoelectricity converter 150-2. - (f-7) shows typically the spectrum of the signal in important section (a-7) - (f-7) of the optical transmitter-receiver shown in drawing 8 (a-7) and drawing 7 .

[0057] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 5th operation gestalt hereafter to drawing 1 based on drawing 7 and drawing 8 . It is a modulation factor md about the subcarrier SC which is the baseband signaling SBB inputted from the outside of the **** sending set 101, and was inputted from the local oscillation section 170 as the 1st operation gestalt explained the baseband modulation section 180 in the optical sending set 101. Amplitude modulation is carried out and it is the modulation electrical signal Smod. It generates. Now, the current wave form of this baseband signaling SBB is set to I (t). This modulation electrical signal Smod Voltage waveform Vd (t) is expressed with a before type (2) and is outputted to the external light modulation section 120.

[0058] The light source 110 outputs the main carrier MC of optical spectrum as shown in drawing 8 (a-7). In addition, this drawing 8 (a-7) is the same as that of drawing 2 (a-1). The external light modulation section 120 is the modulation electrical signal Smod inputted from the baseband modulation section 180 as the 1st operation gestalt explained. Amplitude modulation of the main carrier MC inputted from the light source 110 is carried out, and the double modulation lightwave signal OSdmod of optical spectrum as shown in drawing 8 (b-1) is generated and outputted. In addition, the optical spectrum of drawing 8 (b-7) is the same as that of the thing of drawing 2 (b-1). Moreover, field strength wave [of this double modulation lightwave signal OSdmod] E (t) is eventually mathematized like a before type (7), as the 1st operation

gestalt explained. The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 710. About the inputted double modulation lightwave signal OSdmod, the optical filter section 710 is a band B1, as shown in drawing 8 (b-7). The component and band B-2 of the lower side band contained The passage optical frequency band is set up so that it may divide into the component of a sideband wave when contained, and a main carrier. It is the 1st lightwave signal OS 1 about the component of the lower side band by which the optical filter section 710 was divided. It is the 2nd lightwave signal OS 2 about the component of the sideband wave after carrying out, and carrying out outgoing radiation to the 1st optical fiber 140-1 and being divided, and a main carrier. It carries out and outgoing radiation is carried out to the 2nd optical fiber 140-2.

[0059] Here, the detailed configuration and actuation of the optical filter section 710 are explained based on drawing 8 and drawing 9 . In drawing 9 , the optical filter section 710 contains the optical circulator section 910 which has terminals 1, 2, and 3, and the optical fiber grating section 920. Here, terminals 1, 2, and 3 are connected with the external light modulation section 120, the optical fiber grating section 920, and an optical fiber 140-1. The double modulation lightwave signal OSdmod inputted into the terminal 1 of the external light modulation section 120 to the optical circulator section 910 is outputted only to the optical fiber grating section 920 connected to a terminal 2 as it is. The optical fiber grating section 920 is the band B1 shown in drawing 8 (b-7) among the double modulation lightwave signals OSdmod which are the optical notch filters of a narrow-band and are inputted. It is set up so that only the component contained may be reflected. Therefore, the 1st lightwave signal OS 1 of the above It is reflected, consequently incidence is again carried out to the optical circulator section 910 from a terminal 2, and outgoing radiation is carried out only to the 1st optical fiber 140-1 connected to a terminal 3 as it is. Moreover, since the component of the area outside the reflexogenic zone (band B1 except) is penetrated among the double modulation lightwave signals OSdmod inputted in the optical fiber grating section 920, it is the 2nd lightwave signal OS 2 of the above. Outgoing radiation is carried out to the 2nd optical fiber 140-2. As mentioned above, the optical filter section 710 can realize optical filtering processing of a narrow-band with an easy configuration by combining the optical circulator and optical fiber grating which are the existing optical components.

[0060] This 1st lightwave signal OS 1 Optical spectrum is optical frequency nu-f 0, as shown in drawing 8 (c-7). It is contained in a nearby optical frequency band. This 1st lightwave signal OS 1 Field strength wave EOS 1 (t) is expressed with a degree type (16). Moreover, filing of a degree type (16) obtains a degree type (17).

[Equation 14]

$$E_{OS1}(t) = \frac{E}{2}J_0\left(\frac{km_d}{2}\right)\Big\{ J_1(k)J_0\left(\frac{km_d}{2}\right)\cos(\omega-\omega_0)t - J_0(k)J_1\left(\frac{km_d}{2}\right)\left(\cos(\omega-\omega_0+\omega_1)t+\cos(\omega-\omega_0-\omega_1)t\right)\Big\}\cdots(16)$$

[Equation 15]

$$E_{OS1}(t) = K\cos(\omega-\omega_0)t(1-m'\cos\omega_1 t)\cdots(17)$$

Here, m' and K are expressed with a before type (10) and (11) in a top type (16). Moreover, the 2nd lightwave signal OS 2 of the above Optical spectrum is to [near optical frequency nu] nu+f 0, as shown in drawing 8 (d-1). It is contained in a nearby optical frequency band. This 2nd lightwave signal OS 2 Wave EOS 2 (t) is expressed with a degree type (18).

[Equation 16]

$$E_{OS2}(t) = \frac{E}{2}\cos(2\pi\nu t) + \frac{E}{2}J_1(k)J_0^2\left(\frac{km_d}{2}\right)\cos(\omega+\omega_0)t - \frac{E}{2}J_0(k)J_0\left(\frac{km_d}{2}\right)J_1\left(\frac{km_d}{2}\right)2\cos\omega_1 t\cos(\omega+\omega_0)t\cdots(18)$$

Moreover, if a top type (18) is arranged using m' and K, a degree type (19) will be obtained.

[Equation 17]

$$E_{OS2}(t) = \frac{E}{2}\cos(2\pi\nu t) + K\cos(\omega+\omega_0)t(1-m'\cos\omega_1 t)\cdots(19)$$

[0061] As mentioned above, the 1st lightwave signal OS 1 which was explained based on a formula, drawing 8 , etc. And the 2nd lightwave signal OS 2 It is transmitted with the 1st optical fiber 140-1 and the 2nd optical fiber 140-2, and incidence is carried out to the 1st light receiving set 102-1 and the 2nd light receiving set 102-2. By this, they are both the lightwave signals OS 1. And OS2 It is transmitted to a remote place. First, it is the 1st lightwave signal OS 1 with which incidence of the 1st photoelectricity converter 150-1 was carried out in the 1st light receiving set 102-1. It receives, photoelectricity conversion is performed and an electrical signal is outputted. This 1st lightwave signal OS 1 If drawing 8 (c-7) is referred to, it will be optical frequency nu-f 0. It turns out that a subcarrier is equivalent to that by which amplitude modulation was carried out with baseband signaling SBB (=cos2pif1 t). Therefore, current wave form Ipd1 of the electrical signal which the 1st photoelectricity converter 150-1 outputs (t) is expressed with a degree type (20) like a before type (12).
[Equation 18]

$$I_{pd1}(t) = \frac{\eta_1}{2}K^2(1-m'\cos\omega_1 t)^2$$

$$= I_{pd1}(1-2m'\cos\omega_1 t + m'^2\cos^2\omega_1 t)\cdots(20)$$

However, eta 1 It is the conversion efficiency of the 1st photoelectricity converter 150-1, and is Ipd1. It is a direct-current component. A band pass filter etc. is used from the electrical signal which the 1st photoelectricity converter 150-1 outputs so that he can understand, if a top type (20) is referred to, and it is a frequency f1. If only a component is extracted, as it is shown in drawing 8 (e-7), it is the 1st lightwave signal OS 1. The amplitude modulation component which it has, i.e., current wave form [of baseband signaling SBB] I, (t) will be obtained directly. In addition, frequency f1 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only a component. Here, there should be only a frequency band which can acquire this baseband signaling SBB in the 1st photoelectricity converter 150-1.
[0062] Next, it is the 2nd lightwave signal OS 2 with which incidence of the 2nd photoelectricity converter 150-2 was carried out in the 2nd light receiving set 102-2. It receives, photoelectricity conversion is performed and an electrical signal is outputted. This 2nd lightwave signal OS 2 If drawing 8 (f-7) is referred to, it turns out that it is equivalent to that to which single sideband modulation (Single SideBand Modulation) of the main carrier MC was carried out with the above-mentioned electric modulating signal Smod (signal which carried out amplitude modulation of the subcarrier SC with baseband signaling SBB). Therefore, current wave form Ipd2 of the electrical signal which the 2nd electrical-and-electric-equipment light converter 150-2 outputs (t) is expressed with a degree type (21).
[Equation 19]

$$I_{pd2}(t) = \left(\frac{E}{2}\right)\frac{\eta_2 K}{2}\cos\omega_0 t(1-m'\cos\omega_1 t)\cdots(21)$$

Here, it is eta 2. It is the conversion efficiency of the 2nd photoelectricity converter 150-2, and is Ipd2. It is a direct-current component. A band pass filter etc. is used from the electrical signal which the 2nd photoelectricity converter 150-2 outputs so that he can understand, if a top type (21) is referred to, and it is a frequency f0. If only a component is extracted, as it is shown in drawing 8 (f-7), it is the 2nd lightwave signal OS 2. The amplitude modulation component f0 which it has, i.e., a frequency, Electric modulating signal Smod of a band Directly and naturally it will be obtained. In addition, frequency f0 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only the component of a band. Here, in the 2nd photoelectricity converter 150-2, it is this electric modulating signal Smod. There should be only a frequency band obtained.
[0063] As mentioned above, the optical sending set 101 shown in drawing 7 divides into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side the double modulation lightwave signal OSdmod acquired by modulating a main carrier MC doubly by optical filtering, and carries out optical transmission of each. And the 1st and 2nd light receiving set 102-1 and 102-2 are baseband signaling SBB and the electric modulating signal Smod by carrying out photoelectricity conversion of each separately. It can obtain. In this way, a **** transmitter-receiver is the electric modulating signal Smod which carried out amplitude modulation of the subcarrier SC to baseband signaling SBB now using the same light source 110. Optical transmission can be carried out simultaneously.

[0064] In addition, with the 5th operation gestalt, although the optical filter section 710 was carrying out band division at the component of a lower side band, and the component of a top sideband wave and a main carrier, it may carry out band division at the component of a top sideband wave, and the component of a lower side band and a main carrier. Moreover, electric modulating signal Smod shown in drawing 8 (f-7) f0 In the case of a microwave band or a millimeter wave band, it is suitable to carry out a radio transmission. Then, it is the electric modulating signal Smod to the latter part of the 2nd photoelectricity converter 150-2. The antenna (not shown) which can be emitted to space is formed and it is the electric modulating signal Smod. By leading to the antenna concerned, this optical transmitter-receiver and a radio-transmission system are easily connectable.
[0065] Moreover, the 5th operation gestalt is the electric modulating signal Smod outputted from the baseband modulation section 180. When it is a microwave band and a millimeter wave band, it is the electric modulating signal Smod of this RF. Since it was difficult to carry out direct light modulation of the light source 110 when the frequency response characteristic was taken into consideration, the optical sending set 101 had adopted the external light modulation method. However, electric modulating signal Smod outputted from the baseband modulation section 180 If it is below a microwave band in general, it will not be concerned with the above-mentioned frequency response characteristic, but it is the electric modulating signal Smod concerned. The direct drive of the light source 110 can be carried out, and direct modulation of the output luminous intensity of the light source 110 concerned can also be carried out. That is, a direct light modulation method can also be used for a **** transmitter-receiver.
[0066] (6th operation gestalt) Drawing 10 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 6th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 10 is different at the point further equipped with the 2nd light receiving set 102-2 connected with the optical sending set 101 possible [optical transmission] through the 2nd optical fiber 140-2 in profile as compared with the optical transmitter-receiver shown in drawing 3 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is simplified. In addition, the lightwave signal OS the optical fiber 140 shown in drawing 3 , the optical receiving set 102, and the photoelectricity converter 150 were indicated to be to drawing 3 again in the thing of explanation called for convenience the 1st optical fiber 140-1, the 1st light receiving set 102, and the 1st photoelectricity converter 150-1 with the 6th operation gestalt is the 1st lightwave signal OS 1. It expounds on what is called here. Moreover, the optical sending set 101 shown in drawing 10 is replaced with the optical filter section 130 as compared with the optical transmitter-receiver 101 shown in drawing 3 , and is different at a point equipped with the optical filter section 710. Furthermore, the 2nd light receiving set 102-2 is equipped with the 2nd photoelectricity converter 150-2. Moreover, - (f-10) shows typically the spectrum of the signal in important section (a-10) - (f-10) of the optical transmitter-receiver shown in drawing 11 (a-10) and drawing 10 .
[0067] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 6th operation gestalt hereafter to drawing 3 based on drawing 10 , drawing 11 , etc. In the optical sending set 101, the light source 110 outputs the main carrier MC of optical spectrum as shown in drawing 8 (a-7) to the 1st external light modulation section 120-1, as the 2nd operation gestalt explained. Moreover, the local oscillation section 170 outputs the same subcarrier SC as the above-mentioned to the 1st external light modulation section 120-1. Amplitude modulation is carried out by the subcarrier SC into which the inputted main carrier MC was inputted as the 2nd operation gestalt explained, and the 1st external light modulation section 120-1 is the modulation lightwave signal OSmod. It generates and outputs to the 2nd external light modulation section 120-2. This modulation lightwave signal OSmod As shown in drawing 11 (a-10), since it is the same as that of the optical spectrum of drawing 4 (a-3), optical spectrum omits detailed explanation.
[0068] Moreover, as the 2nd operation gestalt explained, baseband signaling SBB is inputted into the 2nd external light modulation section 120-2 from the exterior of the optical sending set 101. Modulation lightwave signal OSmod into which the 2nd external light modulation section 120-2 was also inputted as the 2nd operation gestalt explained Amplitude modulation is carried out with the inputted baseband signaling SBB, and the double modulation lightwave signal OSdmod is generated. As shown in drawing 11 (b-10), since it is the same as that of the optical spectrum of drawing 4 (b-3), the optical spectrum of this double modulation lightwave signal OSdmod omits detailed explanation. The double modulation lightwave

signal OSdmod which was explained above is inputted into the optical filter section 710. About the inputted double modulation lightwave signal OSdmod, the optical filter section 710 is a band B1, as shown in drawing 11 (b-10). The component and band B-2 of the lower side band contained The passage optical frequency band is set up so that it may divide into the component of a sideband wave when contained, and a main carrier. It is the 1st lightwave signal OS 1 about the component of the lower side band by which the optical filter section 710 was divided. It is the 2nd lightwave signal OS 2 about the component of the sideband wave after carrying out, and carrying out outgoing radiation to the 1st optical fiber 140-1 and being divided, and a main carrier. It carries out and outgoing radiation is carried out to the 2nd optical fiber 140-2. This 1st lightwave signal OS 1 Optical spectrum is optical frequency nu-f 0, as shown in drawing 11 (c-10). It is contained in a nearby optical frequency band. Moreover, the 2nd lightwave signal OS 2 of the above Optical spectrum is to [near optical frequency nu] nu+f 0, as shown in drawing 11 (d-10). It is contained in a nearby optical frequency band. The 1st lightwave signal OS 1 which was explained above And the 2nd lightwave signal OS 2 As the 5th operation gestalt explained, incidence is carried out to the 1st light receiving set 102-1 and the 2nd light receiving set 102-2. By this, they are both the lightwave signals OS 1. And OS2 It is transmitted to a remote place.

[0069] The 1st light receiving set 102-1 and the 2nd light receiving set 102-2 are the baseband signaling SBB which has spectrum as shown in drawing 11 (e-10), and the electric modulating signal (signal which carried out amplitude modulation of the subcarrier with baseband signaling) Smod which has spectrum as shown in drawing 11 (f-10) by operating like the 5th operation gestalt. It outputs. in addition, drawing 11 (f-10) -- setting -- electric modulating signal Smod Electric modulating signal Smod of drawing 8 (f-7) abbreviation -- it is shown identically. However, electric modulating signal Smod which is the effect of the sideband wave component (refer to hatching section) of a main carrier MC, and is shown in accuracy at drawing 11 (f-10) Electric modulating signal Smod shown in drawing 8 (f-7) A big distortion is produced a little. However, since the modulation approach of the 6th operation gestalt is different from the thing of the 5th operation gestalt, most formulas used with the 5th operation gestalt concerned expound on not being applied with the 6th operation gestalt concerned. As mentioned above, according to the optical sending set shown in drawing 10 , optical filtering divides optical spectrum into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side for the double modulation lightwave signal OSdmod (refer to drawing 11 (b-10)) acquired by modulating a main carrier MC doubly (it being amplitude modulation with baseband signaling SBB further about the modulation lightwave signal OSmod acquired by carrying out amplitude modulation of the main carrier by the subcarrier), and optical transmission of each is carried out. And the 1st light receiving set and the 2nd light receiving set can acquire baseband signaling SBB (refer to drawing 11 (e-10)) and the electric modulating signal Smod (refer to drawing 11 (f-10)) by carrying out photoelectricity conversion of each individually. In this way, optical transmission of the signal with which the **** transmitter-receiver also carried out amplitude modulation of the subcarrier to baseband signaling now using the same light source 110 is carried out simultaneously.

[0070] In addition, also in the optical transmitter-receiver shown in drawing 10 , the optical filter section 710 may carry out band division at the component of a top sideband wave, and the component of a lower side band and a main carrier. Moreover, the optical transmitter-receiver shown in drawing 10 also forms an antenna (above-mentioned) in the latter part of the 2nd photoelectricity converter 150-2, and is the electric modulating signal Smod. By leading to the antenna concerned, it is easily connectable with a radio-transmission system. [as well as the optical transmitter-receiver which shows drawing 7] Furthermore, in the optical transmitter-receiver shown in drawing 10 , it became irregular using the subcarrier and the 1st external light modulation section 120-1 was modulating the 2nd external light modulation section 120-2 using baseband signaling. However, the 1st external light modulation section 120-1 may carry out amplitude modulation using baseband signaling, and the 2nd external light modulation section 120-2 may carry out amplitude modulation using a subcarrier.

[0071] (7th operation gestalt) Drawing 12 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 7th operation gestalt of this invention. It differs in that the point which the optical sending set 101 replaces with the optical filter section 710, and is equipped with the optical tee 1210, the point that the 1st light receiving set 102-1 is further equipped with the low pass filter section 1220, and the 2nd light receiving set 102-2 are further equipped with the high pass filter section 1230 as compared with the optical transmitter-receiver which shows the optical transmitter-receiver shown in drawing 12 to drawing 10 . Since it is the same as that of the optical transmitter-receiver shown in drawing

10 about the other configuration, about a corresponding configuration, the same reference mark is attached and the explanation is omitted.
[0072] Hereafter, actuation of the optical transmitter-receiver shown in drawing 12 is explained based on drawing 11 , drawing 12 , etc. The 2nd external light modulation section 120-2 generates the same double modulation lightwave signal OSdmod as the 6th operation gestalt (drawing 11 (b-10 reference)), and outputs it to the optical tee 1210. The optical tee 1210 carries out many branching (it dichotomizes in this explanation) of the inputted double modulation lightwave signal OSdmod, and it carries out outgoing radiation to an optical fiber 140-1 and 140-2. On the other hand, the dichotomous double modulation lightwave signal OSdmod reaches, after this, another side is transmitted in an optical fiber 140-1 and 140-2, and incidence is carried out to the 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2. The 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2 carry out photoelectricity conversion, and output the double modulation lightwave signal OSdmod. in addition, the light-receiving current of the 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2 -- being alike -- naturally the component of baseband signaling SBB (refer to drawing 11 (e-10)) and the component of the electric modulating signal Smod (refer to drawing 11 (f-10)) are contained.
[0073] The electrical signal outputted from the 1st electrical-and-electric-equipment converter 150-1 is inputted into the low pass filter section 1220, and only the part contained in low-pass among the electrical signals concerned passes the filter section 1220 concerned, and is outputted. By this, baseband signaling SBB (refer to drawing 11 (e-10)) can be acquired like the 2nd operation gestalt. On the other hand, the electrical signal outputted from the 2nd electrical-and-electric-equipment light converter 150-2 is inputted into the high pass filter section 1230, and only the part contained among the electrical signals concerned in a quantity region passes the filter section 1230 concerned, and is outputted. Thereby, the electric modulating signal Smod (refer to drawing 11 (f-10)) can be acquired like the 2nd operation gestalt.
[0074] As mentioned above, according to the optical sending set shown in drawing 12 , the double modulation lightwave signal OSdmod which modulated doubly the same main carrier MC as the optical transmitter-receiver shown in drawing 10 is many branched, and optical transmission of each is carried out. And the 1st light receiving set and the 2nd light receiving set are baseband signaling SBB and the electric modulating signal Smod low-pass, after carrying out photoelectricity conversion of each individually, and by carrying out high region filtering. It can obtain. In this way, a **** transmitter-receiver can also carry out optical transmission of baseband signaling and the electric modulating signal simultaneously using the same light source 110. In addition, the 1st and 2nd light receiving set 102-1 mentioned above and 102-2 were equipped with the 1st and 2nd photoelectricity converter 150-1 from which the frequency band in which photoelectricity conversion is possible differs mutually, and 150-2. However, the 1st and 2nd light receiving set 102-1 and 102-2 may be equipped with the photoelectricity converter which has the large frequency band which is mutually the same, and bundles up the double modulation lightwave signal OSdmod and can carry out photoelectricity conversion. As for the 1st and 2nd light receiving set 102-1 and 102-2, also in this case, baseband signaling SBB and the electric modulating signal Smod can be acquired low-pass and by carrying out high region filtering. In addition, the thing except the 6th operation gestalt having explained may be applied as an optical sending set 101 concerning this operation gestalt.
[0075] (8th operation gestalt) With the optical transmitter-receiver shown in drawing 12 , two kinds of optical receiving sets with which configurations differ mutually were connected again. However, if an optical receiving set is constituted as follows, even if only one kind of optical receiving set is connected to the optical transmitter-receiver, they are baseband signaling SBB and the electric modulating signal Smod. Both can be obtained. Hereafter, such an optical receiving set is explained based on drawing 13 which shows the configuration.
[0076] The optical sending set 101 and one or more optical receiving sets 102 are connected to the optical transmitter-receiver shown in drawing 13 possible [optical transmission] through an optical fiber 140. Since the optical sending set 101 shown in drawing 13 is the same as that of the configuration of the optical sending set 101 shown in drawing 12 , the explanation is omitted. The optical receiving set 102 shown in drawing 13 has the configuration which is different as compared with the optical receiving set 102-1 shown in drawing 12 , or 102-2, and is equipped with the photoelectricity converter 150, a distributor 1310, the low pass filter section 1320, and the high pass filter section 1330.
[0077] The double modulation lightwave signal OSdmod by which outgoing radiation was carried out from

the optical sending set 101 is transmitted in each optical fiber 140, and incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102 so that clearly also from ****. The photoelectricity converter 150 has the broadband property which can carry out photoelectricity conversion of low-pass [from] to the high region, carries out photoelectricity conversion of the double modulation lightwave signal OSdmod in package, and outputs the electrical signal acquired by this to a distributor 1310. Probably this electrical signal is allotted by the distributor 1310 (in this explanation, it considers as two distributions). One side of the electrical signal carried out 2 ****s by the distributor 1310 is inputted into the low pass filter section 1320, and only the part contained in low-pass among the electrical signals concerned passes the filter section 1320 concerned, and is outputted. Baseband signaling SBB (refer to drawing 11 (e-10)) is acquired by this.

[0078] Moreover, another side of the electrical signal carried out 2 ****s by the distributor 1310 is inputted into the high pass filter section 1330, and only the part contained among the electrical signals concerned in a quantity region passes the filter section 1330 concerned, and it is outputted. The electric modulating signal Smod (refer to drawing 11 (f-10)) is acquired by this.

[0079] As mentioned above, an optical transmitter-receiver is baseband signaling SBB and the electric modulating signal Smod like [if it has one optical receiving set shown in drawing 13] the optical transmitter-receiver shown in drawing 12. Both can be obtained. In addition, the optical receiving set 102 of plurality (a graphic display is two sets) is connected to drawing 13. However, the number of the optical receiving set 102 may be one set according to the construction conditions of an optical transmitter-receiver. In this case, the optical tee 1210 becomes unnecessary and the 2nd external light modulation section 120-2 carries out outgoing radiation of the double modulation lightwave signal OSdmod to an optical fiber 140. Moreover, in the optical transmitter-receiver concerning the 7th and 8th operation gestalten, the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2 were carrying out amplitude modulation with double sideband amplitude modulation so that clearly, if drawing 11 was referred to. However, the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2 may carry out amplitude modulation with single side band amplitude modulation. According to this single side band amplitude modulation, the double modulation lightwave signal OSdmod has the component of a main carrier MC in the main optical frequency nu first. Further, to optical frequency nu, this double modulation lightwave signal OSdmod is a low high frequency or frequency side, and is optical frequency f0 from the optical frequency nu concerned. It has the component of a top sideband wave or a lower side band in a location. Although such a lightwave signal OSdmod is transmitted in each optical fiber, since it is hard coming for the optical fiber 140 concerned to receive wavelength dispersion effect as compared with the case of double sideband amplitude modulation, more, optical transmission is carried out and it deals in a long distance.

[0080] (9th operation gestalt) Drawing 14 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 9th operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 14, the optical receiving set 102-1 shown in drawing 12 and 102-2, or the optical receiving set 102 shown in drawing 13 is connectable. The optical sending set 101 shown in drawing 14 is replaced with the optical filter section 130 as compared with the optical sending set 101 shown in drawing 5, and is different at a point equipped with the optical tee 1210. In order for there to be no point of difference in addition to it, the same reference mark is given to the corresponding component. Moreover, the optical tee 1210 is also explained with reference to drawing 12 etc. Therefore, about actuation of the optical sending set 101 shown in drawing 14, since it is clearer than these, the explanation is simplified.

[0081] Mode locking of the mode locking light source 510 is carried out by the subcarrier SC inputted from the local oscillation section 170, and it carries out multimode oscillation. If frequency spacing of mode locking is set up equally to the frequency of Subcarrier SC, the modulation lightwave signal OSmod (refer to drawing 11 (a-10)) will be outputted to the external light modulation section 120 from the mode locking light source 510. The external light modulation section 120 is the inputted modulation lightwave signal OSmod. And based on the baseband signaling SBB inputted from the outside, the double modulation lightwave signal OSdmod (refer to drawing 11 (b-10)) is generated, and it outputs to the optical tee 1210. The optical tee 1210 carries out outgoing radiation of the inputted double modulation lightwave signal OSdmod to each optical fiber 140, after many branching. In addition, also in the optical transmitter-receiver shown in drawing 14, that at least one optical receiving set 102 should just be connected, it becomes

unnecessary [the optical tee 1210] and the external light modulation section 120 carries out outgoing radiation of the double modulation lightwave signal OSdmod to an optical fiber 140 at one set of the case.
[0082] (10th operation gestalt) Drawing 15 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 10th operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 15, the optical receiving set 102-1 shown in drawing 12 and 102-2, or the optical receiving set 102 shown in drawing 13 is connectable. The optical sending set 101 shown in drawing 15 is equipped with the 1st light source 1510-1, the 2nd light source 1510-2, the external light modulation section 120, the optical multiplexing section 1520, and the optical tee 1210. In addition, in the optical sending set 101 of drawing 15, about the thing equivalent to the component of the optical sending set of drawing 14, the same reference mark is attached and suppose that the explanation is simplified. - (d-15) shows typically the spectrum of the signal in important section (a-15) - (d-15) of the optical feeder shown in drawing 16 (a-15) and drawing 15.
[0083] Hereafter, actuation of the optical transmitter-receiver concerning the 10th operation gestalt is explained based on drawing 15 and drawing 16. Setting to the optical sending set 101, the 1st light source 1510-1 is the 1st nothing modulation light UML 1 of optical frequency nu. It outputs to the external light modulation section 120. This 1st nothing modulation light UML 1 It has optical spectrum as shown in drawing 16 (a-15). Moreover, frequency f1 Baseband signaling SBB is inputted into the external light modulation section 120 from the exterior of the optical sending set 101. It is the 1st nothing modulation light UML 1 inputted as the 2nd operation gestalt explained the external light modulation section 120. Amplitude modulation is carried out with the inputted baseband signaling SBB, and it is the modulation lightwave signal OSmod. It generates. This modulation lightwave signal OSmod As optical spectrum is shown in drawing 16 (b-15), it is the 1st nothing modulation light UML 1 to the main optical frequency nu. About a component, it is optical frequency nu to the optical frequency f1 further. It has the component of a sideband wave in the location (only for **f 1, a graphic display is) of an integral multiple. Such a modulation lightwave signal OSmod It is inputted into the optical multiplexing section 1520.
[0084] It is the 2nd nothing modulation light UML 2 in which the 2nd light source 1510-2 separated only predetermined optical frequency from the above-mentioned optical frequency nu. It outputs to the optical multiplexing section 1520. This predetermined optical frequency is the frequency f0 of the above-mentioned subcarrier SC. It considers as corresponding optical frequency. This 2nd nothing modulation light UML 2 has optical spectrum as shown in drawing 16 (c-15). The optical multiplexing section 1520 is the inputted modulation lightwave signal OSmod. The 2nd nothing modulation light UML 2 It multiplexs so that those polarization may be put together, and it outputs to the optical tee 1210 as a lightwave signal OS. This lightwave signal OS is the modulation lightwave signal OSmod. The 2nd nothing modulation light UML 2 Since it is only multiplexed, it has optical spectrum as shown in drawing 16 (d-15). It turns out that the optical spectrum of this lightwave signal OS is the same as that of the case where the single side band amplitude modulation explained in the 8th operation gestalt is applied when referring to this drawing 16 (d-15). Therefore, the optical sending set 101 constituted like drawing 15 will also do so the same effectiveness as the case where the single side band amplitude modulation explained in the 8th operation gestalt is applied. Furthermore, with this operation gestalt, optical transmission of baseband signaling SBB and the electric modulating signal Smod can be carried out using two sets (the 1st light source 1510-1 and the 2nd light source 1510-2) only of the light sources, without using the local oscillation section 170 like the 8th operation gestalt. Although this needed to perform electric light conversion twice in the 8th operation gestalt in the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2, as for the optical sending set 101 of this operation gestalt, electric light conversion is only once performed in the external light modulation section 120. Thus, low loss optical transmission is realizable by lessening the count of electric light conversion. Furthermore, the optical sending set 101 of this operation gestalt does not need the electrical part for carrying out amplitude modulation with the electrical signal which should transmit a subcarrier. That is, according to this operation gestalt, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. In connection with this, it becomes possible to constitute an optical transmitter-receiver from low cost simply. Furthermore, the oscillation optical frequency of two sets of the light sources can be easily changed by changing each bias current and ambient temperature. Therefore, electric modulating signal Smod acquired by the optical receiving set side A frequency band can be changed easily. in addition, with the 10th operation gestalt, if drawing 16 is referred to, it understands --

as -- the oscillation optical frequency of the 1st light source 1510-1 -- nu -- it is -- the oscillation optical frequency of the 2nd light source 1510-2 -- nu+f 0 it is -- ****** -- it explained. however, the oscillation optical frequency of the 2nd light source 1510-2 -- nu-f 0 you may be .
[0085] if optical transmission of the analog information concerned is put and carried out to Subcarrier SC in each above operation gestalt when baseband signaling is analog information -- the photoelectricity converter 150, 150-1, and 150-2 -- typical -- a lightwave signal -- square -- since it detects, a secondary higher harmonic may be blocked So, in the optical sending set 101 side, the analog / digital conversion of the baseband signaling of analog information are carried out, and optical transmission of the baseband signaling which is the digital information acquired by this is put and carried out to a subcarrier. Optical receiving set 102 grade carries out the digital to analog of such a lightwave signal after photoelectricity conversion. By this, an optical transmitter-receiver can transmit now the quality information which does not receive harmonic interference.
[0086] Moreover, in the optical transmitter-receiver concerning each operation gestalt, it had become the configuration that baseband signaling was inputted from the outside. However, this baseband signaling is beforehand put on the subcarrier of an intermediate frequency using the predetermined modulation technique (amplitude modulation, frequency modulation, or phase modulation). And if optical transmission is carried out after putting the signal which modulates the subcarrier of an intermediate frequency and is acquired on the subcarrier SC outputted from the local oscillation section 170, in the optical receiving set of each operation gestalt, the subcarrier of an intermediate frequency and the signal which modulated Subcarrier SC now can be acquired, and the optical transmission by the modulation technique will become possible. In addition, the above-mentioned intermediate frequency is the frequency f0 of Subcarrier SC. Although limited to a low frequency, for this, the component of the subcarrier of an intermediate frequency is nu**f 0. If not contained in between, it is because it is difficult to carry out photoelectricity conversion and filtering to accuracy. Moreover, in the optical transmitter-receiver concerning each operation gestalt, two or more subcarriers of the intermediate frequency from which a frequency differs mutually are prepared, different baseband signaling can be put on the subcarrier of an intermediate frequency different, respectively, and optical transmission of these can be collectively carried out by adopting frequency-division multiplex further with it.
[0087] Moreover, it also becomes possible to carry out multiplex [of the mutually different baseband signaling by adopting Time-Division-Multiplexing connection or code division multiple access] to the subcarrier of the intermediate frequency of one wave, and to transmit it to the optical transmitter-receiver concerning each operation gestalt. Furthermore, by using together Frequency-Division-Multiplexing connection, and Time-Division-Multiplexing connection or code division multiple access, more, multiplex [of much information] can be carried out and it can be transmitted. As mentioned above, the electric modulating signal which modulated the subcarrier by the baseband signaling and this which should transmit these after photoelectricity conversion can be simultaneously acquired by dividing optical spectrum into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side, and carrying out optical transmission of the lightwave signal by which amplitude modulation was carried out to the duplex to it by optical filtering, respectively. If this electric modulating signal is a microwave band and a millimeter wave band, it is suitable to carry out a radio transmission. Therefore, according to the **** transmitter-receiver, the system which united the wire net by the optical fiber and the radio-transmission system using an electric modulating signal (RF signals, such as a microwave band and a millimeter wave band) can be built. And in an optical sending set, only one becomes advantageous in respect of construction of an optical transmitter-receiver, the cost of maintenance, etc. not using the light source.
[0088] Moreover, when the lightwave signal of 1.5-micrometer band with the smallest transmission loss is made to transmit to the single mode fiber of 1.3-micrometer band currently generally used, with the lightwave signal to which amplitude modulation of usual was carried out by the signal of a RF like a millimeter wave band, dissipation of the modulation component by distribution arises in several km, but in a **** transmitter-receiver, in order to receive the lightwave signal which has only the component of one sideband wave and by which amplitude modulation was carried out, it also has the description of not being influenced of distribution. Moreover, it is a light amplifier (EDFA;Erbium DopedFiber Amplifier) by using the lightwave signal of 1.5-micrometer band. Since it can also be used, an improvement of light-receiving sensibility is also possible.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] More specifically, this invention relates to the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission] about an optical transmitter-receiver.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The optical transmission which puts and transmits information to light is expected if it is widely used for a future high-throughput telecom network from low loss and broadband nature. For example, the optical transmitter-receiver (the 1st light transmitter-receiver is called hereafter) for carrying out optical transmission of the electric high frequency signal, the optical transmitter-receiver (the 2nd light transmitter-receiver is called hereafter) for carrying out optical transmission of the baseband signaling, etc. are proposed. Hereafter, these two optical transmitter-receivers are concretely explained with reference to a drawing.
[0003] First, the 1st optical transmitter-receiver is explained. recent years, a cellular phone, or PHS (Personal Handyphone System) etc. -- wireless service is expanded quickly. Therefore, utilization of a still higher frequency is considered and the microcell system or pico cel system using the millimeter wave band which is 30GHz - 300GHz in general is being examined. In this cel system, the high frequency signal of a millimeter wave band is emitted from the base transceiver station of a large number connected with the control station, and wireless service is offered. This cel system has various advantages. Since the signal of a millimeter wave band has the large propagation loss in space, it cannot have an adverse effect on the 1st easily to an adjacent cel. Moreover, since the signal of a millimeter wave band is short wavelength, the antenna installed at a control station etc. is miniaturized by the 2nd. Furthermore, to the 3rd, since the signal of a millimeter wave band is a RF, it can take large transmission capacity. By this, implementation may be able to offer a difficult high-speed transport service with the conventional wireless service.
[0004] However, in the radio communications system which applied this cel system, many base transceiver stations are installed in the streets. Therefore, it is required that a base transceiver station should be small and cheap. So, the 1st optical transmitter-receiver which adopted the so-called subcarrier optical transmission method with which research and development are performed briskly in recent years may be applied to a radio communications system. In addition, it is related with a subcarrier optical transmission method, and is "Microwave and millimeter-wave fiber optic technologies for subcarrier transmission systems" (Hiroyo Ogawa, IEICE Transactions on Communications, Vol.E76-B, No.9, pp 1078-1090, September, and 1993), for example. It is described in detail. By this subcarrier optical transmission method, with the modulating signal which puts the information on a sound signal and/or a video signal on a subcarrier, and is acquired, the reinforcement of the main carrier which is a light non-become irregular typically is modulated, and a lightwave signal is acquired by this. Change of the reinforcement which this lightwave signal has is equivalent to change of the amplitude which a modulating signal has, change of a frequency, or change of a phase at a meaning. Since the optical fiber of low loss is used dramatically, when the above-mentioned modulating signal is a millimeter wave band, with a gestalt as it is, the modulating signal concerned is transmitted to a remote place, and sells at a subcarrier optical transmission method.
[0005] Here, drawing 17 is the block diagram showing the configuration of the typical 1st light transmitter-receiver. The 1st light transmitter-receiver is equipped with the light source 110, the external light modulation section 120, an optical fiber 140, the photoelectricity converter 150, the frequency-conversion section 1710, and the recovery section 1720 in drawing 17 . Moreover, the light source 110 and the external light modulation section 120 constitute the optical sending set 101, and the photoelectricity converter 150, the frequency-conversion section 1710, and the recovery section 1720 constitute the optical receiving set 102 in a base transceiver station, and are installed in it by the control station again. However, in drawing 17 , the configuration only about the signal path of a uni directional, i.e., the

configuration only about the signal path transmitted to a control station from a base transceiver station, is shown. electric modulating signal Smod of the millimeter wave band with which the electrical signal which should be transmitted to a control station from a base transceiver station put baseband signaling, such as a sound signal and/or a video signal, on the subcarrier typically in this 1st light transmitter-receiver it is . This electric modulating signal Smod It is inputted into the external light modulation section 120 of the optical sending set 101 through an antenna or amplifier (not shown) from a cellular phone, a PHS terminal, etc. which move in the exterior of a base transceiver station. Moreover, the light source 110 oscillates a light non-become irregular as a main carrier MC, and the main carrier MC concerned is inputted into the external light modulation section 120. The external light modulation section 120 is the electric modulating signal Smod into which extraneous light intensity modulation was carried out and the reinforcement of the inputted main carrier MC was inputted. Based on change of the amplitude which it has, it becomes irregular, and is a lightwave signal OSmod by this. It is obtained. This lightwave signal OSmod by which outgoing radiation is carried out to an optical fiber 140 from the external light modulation section 120 Itself becomes a subcarrier and it is the electric modulating signal Smod. Incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102, conveying the inside of an optical fiber 140 with a gestalt as it is. This photoelectricity converter 150 is the lightwave signal OSmod by which incidence was carried out by performing photoelectricity conversion. It changes into the electrical signal containing a part for that on-the-strength strange preparation. The frequency-conversion section 1710 carries out the down convert of the electrical signal inputted from the photoelectricity converter 150 at the electrical signal of an intermediate frequency band. The recovery section 1720 restores to the information on baseband signaling, such as a sound signal and/or a video signal, based on the electrical signal of the intermediate frequency band inputted from the frequency-conversion section 1710.
 [0006] Next, the 2nd optical transmitter-receiver which carries out optical transmission of the baseband signaling is explained. Drawing 18 is the block diagram showing the configuration of the 2nd typical optical transmitter-receiver. The 2nd light transmitter-receiver is equipped with the light source actuator 1810, the light source 110, an optical fiber 140, and the photoelectricity converter 150 in drawing 18 . The light source actuator 1810 and the light source 110 constitute the optical sending set 101 among them, and the photoelectricity converter 150 constitutes the optical receiving set 102. In this 2nd light transmitter-receiver, the baseband signaling SBB which should be transmitted to the optical receiving set 102 from the optical sending set 101 is assumed to be digital information, such as a sound signal and/or a video signal. Baseband signaling SBB is inputted into the light source actuator 1810. The light source actuator 1810 drives the light source 110, and it becomes irregular based on the baseband signaling SBB into which the reinforcement which the lightwave signal outputted from the light source 110 concerned has was inputted (direct light modulation method). After this lightwave signal is transmitted in the inside of an optical fiber 140, photoelectricity conversion is carried out by the photoelectricity converter 150, and the original baseband signaling SBB is acquired by this. such an optical transmission technique is common, for example, was published in Showa 55 -- "-- an optical-communication technique -- a reader -- " (edited by Shimada, Ohm-Sha publication) -- the 2nd -- a chapter "optical transmission system -- actually -- " -- it is described.

[0007] However, photoelectricity conversion and in order to have to carry out frequency conversion, broadband nature is required of the photoelectricity converter 150 and the frequency-conversion section 1710 which are shown in drawing 17 for the RF signal of a millimeter wave band at accuracy. Otherwise, the recovery section 1720 cannot perform exact recovery processing. Therefore, within the 1st light transmitter-receiver, the electrical parts corresponding to a RF band will be connected. For this connection, the connector, waveguide, or semi rigid cable of dedication is used. Since a waveguide and a semi rigid cable were difficult to process it freely, they had the trouble [transmitter-receiver / 1st / optical] that manufacture was difficult. Moreover, when it was going to transmit the electrical signal of a RF like a millimeter wave band to low loss, the activity of a waveguide was needed, but since it was large compared with a coaxial cable, the magnitude of the waveguide concerned had the trouble that the magnitude of the 1st transmitter-receiver will become large.

[Translation done.]

EFFECT OF THE INVENTION

[The means for solving a technical problem and an effect of the invention] The 1st aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is inputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency concerned further in the location of fixed optical frequency. By carrying out photoelectricity conversion of the lightwave signal inputted from the optical filter section which passes selectively the lightwave signal containing the component of either a top sideband wave and a lower side band out of the double modulation lightwave signal inputted from the double modulation section, and the optical filter section Have further the photoelectricity converter which acquires the electrical signal which should be transmitted, and the optical sending set contains the local oscillation section and the double modulation section at least. It is characterized by for the optical receiving set containing the photoelectricity converter at least, and containing the optical filter section in either the optical sending set concerned and the optical receiving set concerned. Since a photoelectricity converter can acquire directly the electrical signal which should transmit low frequency relatively from a lightwave signal according to the 1st aspect of affairs of the above, like the conventional subcarrier optical transmission, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. Furthermore, in connection with this, it becomes possible to constitute an optical receiving set from low cost simply.
[0012] The 2nd aspect of affairs contains at least one external light modulation section which carries out amplitude modulation of the main carrier inputted from semiconductor laser by the external light modulation method to the semiconductor laser to which the double modulation section outputs a main carrier by the subcarrier by which amplitude modulation was carried out with the electrical signal into which it is inputted from the outside, and which should be transmitted in the 1st aspect of affairs. According to the 2nd aspect of affairs of the above, when the double modulation section is constituted by existing semiconductor laser and the existing external light modulation section, an optical transmitter-receiver is built by low cost.
[0013] In the 2nd aspect of affairs, the 3rd aspect of affairs receives the signal with which the subcarrier by which amplitude modulation was carried out with the electrical signal which should be transmitted is the signal by which a radio transmission is carried out from the outside, and a radio transmission is carried out, and is further equipped with the antenna section supplied to the double modulation section. According to the 3rd aspect of affairs of the above, an optical transmitter-receiver is easily connected with a radio-transmission system by having the antenna section which receives the signal by which a radio transmission is carried out from the outside.
[0014] In the 3rd aspect of affairs, the electrical signal which should be transmitted is a multi-channel signal by which frequency multiplexing was carried out, the electric modulation section is a multi-channel signal, and the 4th aspect of affairs is characterized by generating and outputting a modulation electrical

signal by carrying out amplitude modulation of the subcarrier inputted. An optical transmitter-receiver comes to be able to carry out optical transmission of much information according to the 4th aspect of affairs of the above.
[0015] The electrical signal which should transmit the 5th aspect of affairs in the 3rd aspect of affairs is digital information, and the electric modulation section carries out on-off keying of the subcarrier by digital information. According to the 5th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.
[0016] The 6th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission]. By inputting from the outside the subcarrier modulated with the electrical signal which should be transmitted, and modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the inputted subcarrier concerned The optical spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is inputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency concerned further in the location of fixed optical frequency. The optical filter section which passes selectively the lightwave signal containing the component of either a top sideband wave and a lower side band out of the double modulation lightwave signal inputted from the double modulation section, By carrying out photoelectricity conversion of the 1st lightwave signal inputted from the optical tee which branches and outputs the lightwave signal inputted from the optical filter section to the 1st lightwave signal and the 2nd lightwave signal, and an optical tee With a predetermined time interval with the 1st photoelectricity converter which acquires the electrical signal which should be transmitted, and the 2nd photoelectricity converter which outputs the electrical signal acquired by carrying out photoelectricity conversion of the 2nd lightwave signal inputted from an optical tee as a signal for detection Detect the average of the signal for detection inputted from the 2nd photoelectricity converter, and it is based on the maximum of the detected average. It has further the wavelength control section which controls the wavelength of the double modulation lightwave signal outputted from the double modulation section. It is characterized by for the optical sending set containing the local oscillation section and the double modulation section at least, and for the optical receiving set containing the 1st photoelectricity converter at least, and containing the optical filter section in either the optical sending set concerned and the optical receiving set concerned. According to the 6th aspect of affairs of the above, an optical transmitter-receiver consists of low cost simply like the 1st aspect of affairs, it being expensive and making [corresponded to the subcarrier band which is a RF relatively, and] the difficult electrical part of processing unnecessary. Furthermore, since the wavelength of a double modulation lightwave signal is controlled, the optical filter section can output the lightwave signal to which it can always restore to accuracy.
[0017] The local oscillation section to which the 7th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section The spectrum of the double modulation lightwave signal which is equipped with the double modulation section which generates and outputs a double modulation lightwave signal, and is outputted from the double modulation section The component of a top sideband wave and a lower side band is included in the location where only the frequency of a subcarrier separated the component of a main carrier from the fixed optical frequency concerned further in the location of fixed optical frequency. The 1st lightwave signal with which an optical sending set includes the double modulation lightwave signal inputted from the double modulation section for the component of either a top sideband wave and a lower side band, It divides into the 2nd lightwave signal which contains any of a top sideband wave and a lower side band, or the component of another side in the component list of a main carrier. When it has further the optical filter section which outputs the 1st lightwave signal and the 2nd lightwave signal concerned and the 1st light receiving set carries out photoelectricity conversion of the 1st lightwave signal transmitted from an optical sending set It is characterized by acquiring the signal which modulated the subcarrier with the electrical signal which should be transmitted acquiring the electrical

signal which should be transmitted, and by carrying out photoelectricity conversion of the 2nd lightwave signal with which the 2nd light receiving set is further transmitted from an optical sending set. The 1st lightwave signal of the above is changed into the electrical signal which should be transmitted, when the component of a sideband wave is included and photoelectricity conversion is carried out by the above-mentioned 1st photoelectricity converter, while the double modulation lightwave signal by which double modulation was carried out [above-mentioned] contains. Moreover, the 2nd lightwave signal of the above contains the component of the sideband wave of another side of the double modulation lightwave signal by which double modulation was carried out [above-mentioned], and a main carrier, and when photoelectricity conversion is carried out by the above-mentioned 2nd photoelectricity converter, it is changed into the signal which modulated the subcarrier with the electrical signal which should be transmitted. Thus, according to the 7th aspect of affairs of the above, by the receiving side, both signal which modulated the subcarrier by the electrical signal and this which should be transmitted can be acquired simultaneously. Furthermore, since both signals can be transmitted by non-become irregular light 1 wave so that clearly if the above is referred to, two or more light sources are not needed like a wavelength multiplexing technique, but according to the 7th aspect of affairs of the above, an optical transmitter-receiver can be built by low cost.
[0018] The optical circulator section to which the 8th aspect of affairs outputs the double modulation lightwave signal into which the optical filter section is inputted from the double modulation section as it is in the 7th aspect of affairs, By reflecting the component of either a top sideband wave and a lower side band among the double modulation lightwave signals inputted from the optical circulator section, generate the 1st lightwave signal and it outputs to the optical circulator section. And the optical fiber grating section which generates the 2nd lightwave signal and is outputted to the 2nd light receiving set by penetrating any of the top sideband wave concerned and a lower side band or the component of another side in the component list of a main carrier is included. The optical circulator section outputs further the 1st lightwave signal inputted from the optical fiber grating section as it is to the 1st light receiving set. On the 8th aspect of affairs of the above, since the optical filter section consists of the optical circulators and optical fiber gratings which are the existing optical components, an optical transmitter-receiver consists of low cost simply.
[0019] The 9th aspect of affairs is equipped with the antenna section for the 2nd light receiving set to emit the signal which modulated the subcarrier with the acquired electrical signal which carried out photoelectricity conversion, and which should be transmitted to space in the 7th aspect of affairs. The subcarrier modulated with the above-mentioned electrical signal which should carry out transmission is a suitable signal for a radio transmission. Then, according to the 9th aspect of affairs, an optical transmitter-receiver is easily connected with a radio-transmission system by having the antenna section in which the 2nd light receiving set emits this subcarrier to space.
[0020] The electrical signal which should transmit the 10th aspect of affairs in the 7th aspect of affairs is characterized by being changed into digital information by analog information. According to the 10th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.
[0021] The 11th aspect of affairs is characterized by carrying out multiplex [of the electrical signal with which the electrical signal which should be transmitted modulated the subcarrier of an intermediate frequency by analog information or digital information] by plurality and the predetermined multiplex system in the 7th aspect of affairs. In the 11th aspect of affairs, the predetermined multiplex system of the 12th aspect of affairs is Frequency-Division-Multiplexing connection, Time-Division-Multiplexing connection, or code division multiple access. An optical transmitter-receiver carries out multiplex [of much information], and comes to be able to carry out optical transmission of it according to the 11th and 12th aspects of affairs of the above.
[0022] The local oscillation section to which the 13th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section It has the double modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs the double modulation lightwave signal inputted from the double modulation section. By passing the component

contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set] It has the low pass filter section which outputs the electrical signal which should be transmitted. The 2nd light receiving set The component contained in the high region of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set is passed, and it has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted. The receiving side of the 13th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.
[0023] The local oscillation section to which the 14th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By modulating to a duplex the main carrier which is a light which has fixed optical frequency non-become irregular by the electrical signal into which it is inputted from the outside and which should be transmitted, and the subcarrier inputted from the local oscillation section The photoelectricity converter which it has the double modulation section which generates and outputs a double modulation lightwave signal, and an optical receiving set carries out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. The receiving side of the 14th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.
[0024] The 15th aspect of affairs is the electrical signal into which the double modulation section is inputted from the outside in the 7th, 13th, or 14th aspect of affairs and which should be transmitted. With the modulation electrical signal inputted as the electric modulation section which generates and outputs a modulation electrical signal by carrying out amplitude modulation of the subcarrier inputted from the local oscillation section, and the light source which outputs the main carrier which is a light which has fixed optical frequency non-become irregular from the electric modulation section By carrying out amplitude modulation of the main carrier inputted from the light source, the external light modulation section which generates a double modulation lightwave signal is included. According to the 15th aspect of affairs of the above, in order to transmit simultaneously the signal which modulated the subcarrier by the electrical signal and this which should be transmitted to a receiving side, the same light source is used for an optical sending set. An optical transmitter-receiver is built by low cost by this.
[0025] The electrical signal which should transmit the 16th aspect of affairs in the 15th aspect of affairs is digital information, and the electric modulation section carries out on-off keying of the subcarrier by digital information. According to the 16th aspect of affairs of the above, an optical transmitter-receiver can transmit quality information.
[0026] The 17th aspect of affairs is the light source which outputs the main carrier whose double modulation section is a light which has fixed optical frequency non-become irregular in the 7th, 13th, or 14th aspect of affairs, and the subcarrier inputted from the local oscillation section. With the electrical

signal which is inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the main carrier inputted from the light source, and the outside and which should be transmitted By carrying out amplitude modulation of the modulation lightwave signal inputted from the 1st external light modulation section, the 2nd external light modulation section which generates a double modulation lightwave signal is included.
[0027] The 18th aspect of affairs is the light source which outputs the main carrier whose double modulation section is a light which has fixed optical frequency non-become irregular in the 7th, 13th, or 14th aspect of affairs, and the electrical signal which is inputted from the outside and which should be transmitted. By the subcarrier inputted from the 1st external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the main carrier inputted from the light source, and the local oscillation section By carrying out amplitude modulation of the modulation lightwave signal inputted from the 1st external light modulation section, the 2nd external light modulation section which generates a double modulation lightwave signal is included. According to the above 17th and the aspect of affairs of 18, in order to transmit simultaneously the signal which modulated the subcarrier by the electrical signal and this which should be transmitted to a receiving side, the same light source is used for an optical sending set. An optical transmitter-receiver is built by low cost by this.
[0028] The 19th aspect of affairs is characterized by the double modulation section becoming irregular by the subcarrier into which a main carrier is inputted from the local oscillation section by single side band amplitude modulation in the 13th or 14th aspect of affairs. According to the 19th aspect of affairs of the above, by applying single side band amplitude modulation, a double modulation lightwave signal stops being influenced of wavelength dispersion easily in the optical fiber as an optical transmission line, and the transmission distance becomes long.
[0029] The local oscillation section to which the 20th aspect of affairs is the optical transmitter-receiver to which the optical sending set and the 1st and 2nd light receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By carrying out mode locking based on the subcarrier inputted from the local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted By carrying out amplitude modulation of the mode locking lightwave signal inputted from the mode locking light source It has the external light modulation section which generates and outputs a double modulation lightwave signal, and the optical tee which branches and outputs the double modulation lightwave signal inputted from the external light modulation section. By passing the component contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set] By having the low pass filter section which outputs the electrical signal which should be transmitted, and passing the component contained in the high region of the electrical signal acquired by the 2nd light receiving set carrying out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted. The receiving side of the 20th aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.
[0030] The local oscillation section to which the 21st aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and an optical sending set outputs the subcarrier of constant frequency, By carrying out mode locking based on the subcarrier inputted from the local oscillation section, and oscillating at intervals of the optical frequency relevant to the subcarrier concerned With the electrical signal which is inputted as the mode locking light source which generates and outputs a mode locking lightwave signal from the outside and which should be transmitted By carrying out amplitude modulation of the mode locking lightwave signal inputted from the mode locking light source The photoelectricity converter which it has

the external light modulation section which generates and outputs a double modulation lightwave signal, and an optical receiving set carries out photoelectricity conversion of the double modulation lightwave signal transmitted from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. The receiving side of the 21st aspect of affairs of the above like the 7th aspect of affairs the low pass filter section and the high pass filter section Since a part for a part for the low-pass area part of the electrical signal acquired by carrying out photoelectricity conversion of the double modulation lightwave signal and a high-pass area part is passed The signal which modulated the subcarrier with the electrical signal which is relatively included in low-pass, and which should be transmitted, and the electrical signal which is included relatively in a high region, and which should be transmitted can be acquired simultaneously, and an optical transmitter-receiver can be further built by low cost.

[0031] The 22nd aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and is the 1st light source which outputs the 1st nothing modulation light in which an optical sending set has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted. The external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the 1st nothing modulation light inputted from the 1st light source, The 2nd light source which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from the 1st optical frequency, The modulation lightwave signal inputted from the external light modulation section, and the 2nd nothing modulation light inputted from the 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement It has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from the optical multiplexing section. By passing the component contained in low-pass [of the electrical signal acquired by the 1st light receiving set carrying out photoelectricity conversion of the lightwave signal transmitted from an optical sending set] By having the low pass filter section which outputs the electrical signal which should be transmitted, and passing the component contained in the high region of the electrical signal acquired by the 2nd light receiving set carrying out photoelectricity conversion of the lightwave signal transmitted from an optical sending set It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be transmitted.

[0032] The 23rd aspect of affairs is the optical transmitter-receiver to which the optical sending set and the optical receiving set were connected possible [optical transmission], and is the 1st light source which outputs the 1st nothing modulation light in which an optical sending set has the 1st optical frequency, and the electrical signal which is inputted from the outside and which should be transmitted. The external light modulation section which generates and outputs a modulation lightwave signal by carrying out amplitude modulation of the 1st nothing modulation light inputted from the 1st light source, The 2nd light source which outputs the 2nd nothing modulation light which has the 2nd optical frequency from which only predetermined optical frequency differs from the 1st optical frequency, The modulation lightwave signal inputted from the external light modulation section, and the 2nd nothing modulation light inputted from the 2nd light source by multiplexing so that the polarization of the modulation lightwave signal concerned and the 2nd nothing modulation light concerned may be in agreement The photoelectricity converter which it has the optical multiplexing section which generates and outputs a lightwave signal, and the optical tee which branches and outputs the lightwave signal inputted from the optical multiplexing section, and an optical receiving set carries out photoelectricity conversion of the lightwave signal transmitted from an optical sending set, and outputs an electrical signal, By passing the component contained in low-pass [of the electrical signal distributed by the distribution section which allots at least the electrical signal inputted from a photoelectricity converter for 2 minutes, and the distribution section] It has the high pass filter section which outputs the signal which modulated the subcarrier with the electrical signal which should be

transmitted by passing the component contained in the high region of the electrical signal distributed by the low pass filter section which outputs the electrical signal which should be transmitted, and the distribution section. According to the 22nd and 23rd aspects of affairs, a modulation lightwave signal is generated by carrying out amplitude modulation with the electrical signal which the 1st nothing modulation light should transmit. A lightwave signal is generated by being multiplexed with the 2nd nothing modulation light in this modulation lightwave signal. For example, although electric light conversion needed to be twice performed on the 7th aspect of affairs, the optical sending set of this aspect of affairs performs electric light conversion only once. Thus, low loss optical transmission is realizable by lessening the count of electric light conversion. Furthermore, the optical sending set of this aspect of affairs does not need the electrical part for carrying out amplitude modulation with the electrical signal which should transmit a subcarrier. That is, according to this aspect of affairs, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. In connection with this, it becomes possible to constitute an optical transmitter-receiver from low cost simply.

[0033] The 24th aspect of affairs is characterized by installing the antenna section for emitting to space the signal which modulated the subcarrier with the electrical signal which is outputted from the high pass filter section concerned, and which should be transmitted in the latter part of the high pass filter section in the 13th, the 14th and the 20th - the 23rd one of aspects of affairs. According to the 24th aspect of affairs of the above, an optical transmitter-receiver is simply connected with a radio-transmission system like the 13th aspect of affairs.

[0034] the 25th aspect of affairs -- the 7th, the 13th, the 14th, and the 20- the electrical signal which the 23rd should not be but should be transmitted in that aspect of affairs is characterized by modulating the subcarrier of an intermediate frequency which has a frequency lower than the subcarrier outputted from the local oscillation section by analog information or digital information. When the electrical signals which should be transmitted are the above electrical signals, in the receiving side of the optical transmitter-receiver concerning the 25th aspect of affairs of the above, the subcarrier of the intermediate frequency modulated with the analog signal etc. and the signal which modulated the subcarrier now are acquired. By this, the optical transmission by the type of modulation of an optical transmitter-receiver becomes possible.

[0035]

[Embodiment of the Invention]

(1st operation gestalt) Drawing 1 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 1st operation gestalt of this invention. The optical sending set 101 and the optical receiving set 102 are connected to the optical transmitter-receiver shown in drawing 1 possible [optical transmission] through an optical fiber 140. The optical sending set 101 is equipped with the light source 110, the external light modulation section 120, the optical filter section 130, and the antenna section 190, and the optical receiving set 102 is equipped with the photoelectricity converter 150. Moreover, - (d-1) shows typically the spectrum of the signal in important section (a-1) - (d-1) of the optical transmitter-receiver shown in drawing 2 (a-1) and drawing 1 .

[0036] Hereafter, actuation of the optical transmitter-receiver shown in drawing 1 is explained based on drawing 1 and drawing 2 . It sets to the optical sending set 101, and is constant frequency f0 in the antenna section 190. The electric subcarrier SC is a frequency f1. The radio transmission of the signal (the modulation electrical signal Smod is called hereafter) by which amplitude modulation was carried out with the baseband signaling SBB which should be transmitted is carried out from the outside. The antenna section 190 is this modulation electrical signal Smod. It receives and outputs to the external light modulation section 120. Now, the current wave form of this baseband signaling SBB is set to I (t). Moreover, this amplitude modulation is a modulation factor md. Suppose that it is carried out. Then, this modulation electrical signal Smod Voltage waveform Vd (t) is expressed with a degree type (1).

Vd (t) =(1+md I (t)) cos (omega0 t) -- (1)

here -- omega0 =2pif0 it is . Moreover, when (1+md I(t)) is placed with D (t), a top type (1) is expressed with a degree type (2).

Vd (t) =D (t) cos (omega0 t) -- (2)

[0037] The light source 110 consists of semiconductor laser typically, oscillates a light of the fixed optical frequency nu as shown in drawing 2 (a-1) non-become irregular, and outputs this as a main carrier MC.

The external light modulation section 120 is the modulation electrical signal Smod which has the configuration of for example, a Mach TSUENDA mold, and is inputted from the antenna section 190. Amplitude modulation of the main carrier MC inputted from the light source 110 is carried out, and the lightwave signal (the double modulation lightwave signal OSdmod is called hereafter) modulated by the duplex by this is generated. More specifically, the external light modulation section 120 of a Mach TSUENDA mold dichotomizes the inputted main carrier MC first. It is the modulation electrical signal Smod into which while branched and the main carrier MC was inputted. An optical phase modulation is carried out. It is multiplexed with the main carrier MC of branched another side in this main carrier MC by which the optical phase modulation was carried out, and the above-mentioned double modulation lightwave signal OSdmod is generated by this. Amplitude change of the double modulation lightwave signal OSdmod is the modulation electrical signal Smod. The optical spectrum is optical frequency nu to the optical frequency f0 further about the component of a main carrier MC to the main optical frequency nu, as amplitude change is supported at a meaning and it is shown in drawing 2 (b-1). It has the component of a sideband wave (a top sideband wave and lower side band) in the location (only for **f 0, a graphic display is) of an integral multiple. The occupancy frequency band of this double sideband component is the above-mentioned frequency f1. It depends.

[0038] Next, field strength wave [of this double modulation lightwave signal OSdmod] E (t) is mathematized. It is Vpi about the minimum value of the difference of input voltage in case the amplitude of the double modulation lightwave signal OSdmod outputted from the external light modulation section 120 serves as 0 and max. It carries out and it is assumed that the phase contrast between the main carrier MC it is multiplexed [main carrier] within the external light modulation section 120, and the main carrier MC by which the phase modulation was carried out is further set as pi/2. If this assumption is followed, the double modulation lightwave signal OSdmod is expressed with a degree type (3).

[Equation 1]

$$\begin{aligned} E(t) &= \frac{E}{2}\{\cos(2\pi\nu t) + \cos(2\pi\nu t)\cos(\delta_1) - \sin(2\pi\nu t)\sin(\delta_1)\} \\ &= \frac{E}{2}\{\cos(2\pi\nu t) - \cos(kD(t)\cos(\omega_0 t)\sin(2\pi\nu t) \\ &\qquad - \sin(kD(t)\cos(\omega_0 t))\cos(2\pi\nu t)\ \}\cdots(3) \end{aligned}$$

however, k=pi/2Vpi it is -- delta 1 It is expressed with a degree type (4).

[Equation 2]

$$\delta_1 = \frac{\pi D(t)\cos(\omega_0 t)}{2\quad V_\pi} + \frac{\pi}{2}\cdots(4)$$

For example, baseband signaling SBB is delta 1 when it assumes that it is a sine wave and the current wave form is expressed as I(t) =cos (omega1 t) (omega1 =2pif1). It is expressed with a degree type (5), and a top type (3) can be developed like a degree type (6), if a degree type (5) is used.

[Equation 3]

$$\delta_1 = k(1+m_d\cos(\omega_1 t))\cos(\omega_0 t) + \frac{\pi}{2}\cdots(5)$$

[Equation 4]

$$\begin{aligned} E(t) &= \frac{E}{2}\cos(2\pi\nu t) \\ &\quad -\frac{E}{2}\cos(k(1+m\cos(\omega_1 t))\cos(\omega_0 t))\cos(2\pi\nu t) \\ &\quad -\frac{E}{2}\sin(k(1+m\cos(\omega_1 t))\cos(\omega_0 t))\cos(2\pi\nu t)\cdots(6) \end{aligned}$$

Moreover, it sets at a top ceremony (6) and is optical frequency nu, and the nu and f1 concerned. And f0 Consideration of even the primary term expresses field strength wave [of the double modulation lightwave signal OSdmod] E (t) with a degree type (7) eventually.

[Equation 5]

$$E(t)=\frac{E}{2}\cos(2\pi\nu t)$$
$$1+2J_1(k)J_0^2(\frac{km_d}{2})\cos(\omega_0 t)$$
$$-2J_0(k)J_0(\frac{km_d}{2})J_1(\frac{km_d}{2})(\cos(\omega_0+\omega_1)t+\cos(\omega_0-\omega_1)t)\cdots(7)$$

Here, it is J0. It is a zero-order Bessel function, and is J1. It is the primary Bessel function.
[0039] The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130. The passband of the optical filter section 130 is set up so that only the component of a top sideband wave or the component of a lower side band can be extracted among each component which the double modulation lightwave signal OSdmod shown in drawing 2 (b-1) has. For example, the passband of the optical filter section 130 is optical frequency nu+f 0. When set as near (refer to the part surrounded by the dotted line among drawing 2 (b-1)), only the component of a top sideband wave passes the optical filter section 130 concerned as a lightwave signal OS. The optical spectrum of this lightwave signal OS has only the same component as an above top sideband wave, as shown in drawing 2 (c-1), and it is optical frequency nu+f 0. It is contained in a nearby optical frequency band.
[0040] the field strength wave of this lightwave signal OS -- Ef (t) is expressed with a degree type (8). Moreover, filing of a degree type (8) obtains a degree type (9).
[Equation 6]
$$E_f(t)=\frac{E}{2}J_0(\frac{km_d}{2})$$
$$J_1(k)J_0(\frac{km_d}{2})\cos(\omega+\omega_0)t$$
$$-J_0(k)J_1(\frac{km_d}{2})(\cos(\omega+\omega_0+\omega_1)t+\cos(\omega+\omega_0-\omega_1)t)\cdots(8)$$

[Equation 7]
$$E_f(t)=K\cos(\omega+\omega_0)t(1-m'\cos\omega_1 t)\cdots(9)$$

Here, in a top type (8) and (9), it is omega=2pinu, and m' is expressed with a degree type (10) in a top type (9), and K is expressed with a degree type (11).
[Equation 8]
$$m'=\frac{J_0(k)J_1(\frac{km_d}{2})}{J_1(k)J_0(\frac{km_d}{2})}\cdots(10)$$

[Equation 9]
$$K=\frac{E}{2}J_0(\frac{km_d}{2})J_1(k)J_0(\frac{km_d}{2})\cdots(11)$$

[0041] Outgoing radiation is carried out to an optical fiber 140 from the optical filter section 130, the lightwave signal OS explained with reference to a formula and drawing 2 (c-1) above is transmitted with an optical fiber 140, and incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102. A lightwave signal OS will be transmitted to a remote place by this. This photoelectricity converter 150 performs photoelectricity conversion to the lightwave signal OS by which incidence was carried out, and outputs an electrical signal. This lightwave signal OS will be optical frequency nu+f 0, if drawing 2 (c-1) is referred to. It turns out that it is equivalent to that by which amplitude modulation was carried out with the baseband signaling SBB (=cos2pif1 t) whose subcarrier is the information which should be transmitted. Therefore, the current wave form Ipd of the electrical signal which the photoelectricity converter 150 outputs (t) is expressed with a degree type (12).
[Equation 10]
$$I_{pd}(t)=\frac{\eta}{2}K^2(1-m'\cos\omega_1 t)^2$$
$$=I_{pd}(1-2m'\cos\omega_1 t+m'^2\cos^2\omega_1 t)\cdots(12)$$

However, eta is the conversion efficiency of the photoelectricity converter 150, and Ipd is a direct-current

component. It is the output electrical signal of the photoelectricity converter 150 to omega 1 so that it may understand, if a top type (12) is referred to. If only a component (component of a frequency f1) is extracted, as shown in drawing 2 (d-1), the amplitude modulation component which a lightwave signal OS has, i.e., current wave form [of baseband signaling SBB] I, (t) will be obtained directly. In addition, omega 1 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only a component. Thus, the photoelectricity converter 150 is a frequency f1. Broadband nature like the usual subcarrier optical transmission is not required that what is necessary is just to have the frequency characteristics of a band.
[0042] In the above explanation, it was assumed that baseband signaling SBB is got blocked from a viewpoint of the simplification of explanation as it is I(t) =cos (omega1 t), and it was a signal of one channel. However, whether baseband signaling SBB is a signal of multi-channel or it is expressed I(t) =cos(omega1 t)+cos(omega2 t)+-- that is, in a **** transmitter-receiver, it can get over like the signal of one channel. Moreover, when especially the baseband signaling SBB is digital information, it is the modulation electrical signal Smod. The component of Subcarrier SC will be called ASK (Amplitude Shift Keying) and on-off keying (On Off Keying), digital amplitude modulation will be carried out, and a **** transmitter-receiver can carry out now optical transmission of the quality information by this.
[0043] Moreover, when both side-band modulation of the subcarrier SC is carried out with the baseband signaling SBB (=I (t)) of digital information, it is the modulation electrical signal Smod. Voltage waveform Vd (t) is expressed with a degree type (13).
[Equation 11]

$$V_d(t) = D(t)\cos(\omega_0 t) = m_d I(t)\cos(\omega_0 t) \cdots (13)$$

Moreover, field strength wave [of the double modulation lightwave signal OSdmod outputted from the external light modulation section 120] E (t) is called for like a degree type (14) at this time.
[Equation 12]

$$E(t) = \frac{E}{2}(\cos(\omega t) - J_0(k)\sin(\omega t))$$
$$+\frac{E}{2}J_1(k)\cos(\omega+\omega_0)t + \frac{E}{2}J_1(k)\cos(\omega-\omega_0)t \cdots (14)$$

After the double modulation lightwave signal OSdmod expressed with a top type (14) passing the optical filter section 130 and carrying out optical transmission of the optical fiber 140 as a lightwave signal OS, incidence of it is carried out to the photoelectricity converter 150. As mentioned above, the photoelectricity converter 150 performs photoelectricity conversion to the lightwave signal OS by which incidence was carried out, and outputs an electrical signal. The current wave form Ipd of an electrical signal (t) is expressed with a degree type (15).
[Equation 13]

$$I_{pd}(t) - \frac{\eta}{2}\left(\frac{E}{2}J_1(km_d I(t))\right)^2$$
$$\doteqdot \frac{\eta}{2}\left(\frac{E}{2}\frac{km_d I(t)}{2}\right)^2 \cdots (15)$$

It is set to kmd I(t) <<1 in a top type (15). Thus, the output current wave of the photoelectricity converter 150 will be acquired as a recovery signal as it is so that clearly [in the case of both side-band modulation] also from a top type (15). Moreover, a top type (15) shows that Ipd (t) receives the secondary change to the primary change of I (t). Therefore, if M-ASK (multiplex ASK modulation technique) is adopted, since threshold spacing of Ipd (t) will double by the decibel compared with threshold spacing of I (t), it turns out that a lightwave signal OS becomes strong to a noise with a possibility of generating on an optical transmission line (optical fiber).
[0044] In addition, although the phase contrast between the main carrier MC it is multiplexed [main carrier] within the external light modulation section 120 here, and the main carrier by which the phase modulation was carried out was assumed to be pi/2, even when phase contrast is except pi/2, the same effectiveness is acquired fundamentally. Furthermore, the same effectiveness is acquired even when the external optical modulator of an electric-field absorption mold etc. is used instead of the external optical modulator of a Mach TSUENDA mold. As explained above, in addition to the electrical part (the down

converter and demodulator of a millimeter wave band) of the required RF becoming unnecessary with the conventional optical transmitter-receiver, in a **** transmitter-receiver, RF components which are hard to deal with it, such as a waveguide and a semi rigid cable, become completely unnecessary by carrying out optical transmission of the electrical signal of a RF called a millimeter wave band, and carrying out optical signal processing to this lightwave signal by optical signal processing, further. This enables it to miniaturize the magnitude of an optical transmitter-receiver dramatically.

[0045] moreover, the optical spectrum shown in drawing 2 (b-1) in order to carry out external light modulation of the main carrier with the electrical signal of a RF called a millimeter wave band -- setting -- optical frequency spacing between a main carrier component and a sideband wave component -- being large (equivalent to a millimeter wave band) -- the optical filter section 130 can extract only a sideband wave component to accuracy with the present technique by this. In addition, at the 1st operation gestalt, the external light modulation section 120 is the electric modulating signal Smod of a millimeter wave band so that remarkable technical effectiveness may be done so. It is made to carry out light modulation of the main carrier MC. However, electric modulating signal Smod of the frequency band with the other external light modulation section 120 Even if it carries out light modulation, the optical receiving set 102 can restore to baseband signaling SBB, without needing an electrical part (a down converter and demodulator). That is, the optical transmitter-receiver concerning the 1st operation gestalt can be applied to a larger frequency band, without being restricted to a millimeter wave band.

[0046] Moreover, the optical transmitter-receiver concerning the 1st operation gestalt is the modulation electrical signal Smod which is a millimeter wave band. Since it was difficult when carrying out direct light modulation took into consideration the frequency response characteristic of the light source 110, the external light modulation method had been adopted. However, modulation electrical signal Smod If it is below a microwave band in general, it will not be concerned with the above-mentioned frequency response characteristic, but it is the modulation electrical signal Smod concerned. The direct drive of the light source 110 can be carried out, and direct modulation of the output luminous intensity of the light source 110 concerned can also be carried out. That is, a direct light modulation method can also be used for a **** transmitter-receiver. Moreover, in the optical transmitter-receiver concerning the 1st operation gestalt, the optical filter section 130 of the optical sending set 101 extracted the lightwave signal OS from the double modulation signal OSdmod, and was carrying out outgoing radiation to the optical fiber 140. However, the optical receiving set 102 may be equipped with the optical filter section 130. In this case, the optical sending set 101 carries out outgoing radiation of the double modulation lightwave signal OSdmod generated in the external light modulation section 120 to the direct optical fiber 140. The optical receiving set 102 performs photoelectricity conversion to the extracted lightwave signal OS by the photoelectricity converter 150 currently postposed, after extracting a lightwave signal OS from the double modulation lightwave signal OSdmod by which incidence was carried out from the optical fiber 140 by the optical filter section 130 prefaced.

[0047] (2nd operation gestalt) Drawing 3 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 2nd operation gestalt of this invention. The optical sending set 101 and the optical receiving set 102 are connected to the optical transmitter-receiver shown in drawing 3 possible [optical transmission] through an optical fiber 140. The optical sending set 101 is equipped with the light source 110, the 1st and 2nd external light modulation section 120-1 and 120-2, the optical filter section 130, and the local oscillation section 170, and the optical receiving set 102 is equipped with the photoelectricity converter 150. - (b-3) shows typically the spectrum of the signal in important section (a-3) - (b-3) of the optical transmitter-receiver shown in drawing 4 (a-3) and drawing 3 .

[0048] Hereafter, actuation of the optical transmitter-receiver shown in drawing 3 is explained based on drawing 3 , drawing 4 , etc. In the optical sending set 101, the light source 110 consists of semiconductor laser typically, oscillates a light of the fixed optical frequency nu as shown in drawing 2 (a-1) non-become irregular, and outputs it to the 1st external light modulation section 120-1 by making this into a main carrier MC. Moreover, the local oscillation section 170 is the constant frequency f0 of a millimeter wave band. The electric subcarrier SC is outputted to the 1st external light modulation section 120-1. The 1st external light modulation section 120-1 has the configuration of for example, a Mach TSUENDA mold (refer to the 1st operation gestalt), and it carries out amplitude modulation by the subcarrier SC into which the inputted main carrier MC (refer to drawing 2 (a-1)) was inputted. By this, it is the modulation lightwave signal OSmod. It is generated and is outputted to the 2nd external light modulation section 120-2. This

modulation lightwave signal OSmod It has the component of a main carrier MC in the main optical frequency nu, and optical spectrum has the component of a sideband wave (a top sideband wave and lower side band) further in the location (only for **f 0, a graphic display is) of the integral multiple of optical frequency nu to the optical frequency f0, as shown in drawing 4 (a-3).
[0049] Moreover, frequency f1 The baseband signaling SBB which should be transmitted is inputted into the 2nd external light modulation section 120-2 from the exterior of the optical sending set 101. It has the configuration of a Mach TSUENDA mold (refer to the 1st operation gestalt), and amplitude modulation also of the 2nd external light modulation section 120-2 is carried out with the baseband signaling SBB into which the inputted modulation lightwave signal OSmod (refer to drawing 4 (a-3)) was inputted. The double modulation lightwave signal OSdmod is generated by this. The optical spectrum of this double modulation lightwave signal OSdmod is optical frequency nu to the optical frequency f0 further about the component of a main carrier MC to the main optical frequency nu, as shown in drawing 4 (b-3). It has the component of a sideband wave (a top sideband wave and lower side band) in the location (only for **f 0, a graphic display is) of an integral multiple. Moreover, the occupancy frequency band of a double sideband component is a frequency f1. It depends. In addition, in drawing 4 (b-3), the component of baseband signaling SBB is the point generated also to a main carrier MC, and is different from what was shown in drawing 2 (b-1). The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130. In the optical transmitter-receiver shown in drawing 3 , the component after the optical filter section 130 performs the same actuation as the component which corresponds in the optical transmitter-receiver shown in drawing 1 . Therefore, suppose that explanation of the above-mentioned component which carries out an equivalent is omitted with the 2nd operation gestalt. However, since the modulation approach of the 2nd operation gestalt is different from the thing of the 1st operation gestalt, most formulas used with the 1st operation gestalt concerned expound on not being applied with the 2nd operation gestalt concerned.
[0050] In addition, in the optical transmitter-receiver shown in drawing 3 , it became irregular using Subcarrier SC and the 1st external light modulation section 120-1 was modulating the 2nd external light modulation section 120-2 using baseband signaling SBB. However, the 1st external light modulation section 120-1 may carry out amplitude modulation using baseband signaling SBB, and the 2nd external light modulation section 120-2 may carry out amplitude modulation using Subcarrier SC. Moreover, also with the optical transmitter-receiver concerning the 2nd operation gestalt, the optical filter section 130 of the optical sending set 101 extracted the lightwave signal OS from the double modulation signal OSdmod, and was carrying out outgoing radiation to the optical fiber 140. However, the optical receiving set 102 may be equipped with the optical filter section 130. In this case, the optical sending set 101 carries out outgoing radiation of the double modulation lightwave signal OSdmod generated in the 2nd external light modulation section 120-2 to the direct optical fiber 140. The optical receiving set 102 performs photoelectricity conversion to a lightwave signal OS by the postposed photoelectricity converter 150, after extracting a lightwave signal OS from the double modulation lightwave signal OSdmod by which incidence was carried out from the optical fiber 140 by the prefaced optical filter section 130.
[0051] (3rd operation gestalt) Drawing 5 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 3rd operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 5 , the optical receiving set 102 shown in drawing 1 or drawing 3 is connectable. The optical sending set 101 shown in drawing 5 is equipped with the local oscillation section 170, the mode locking light source 510, the external light modulation section 120, and the optical filter section 130.
[0052] Hereafter, the optical sending set 101 shown in drawing 5 is explained with reference to drawing 2 , drawing 4 , and drawing 5 . The local oscillation section 170 outputs the same subcarrier SC as ****. Mode locking of the mode locking light source 510 is carried out by the inputted subcarrier SC, and it carries out multimode oscillation. Which approach may be used for it although the approach of this mode locking has some which are depended on an electric drive or optical impregnation. It is the modulation lightwave signal OSmod shown in (a-3) of drawing 4 from the mode locking light source 510 when setting up spacing of the frequency which carries out mode locking equally to the frequency of Subcarrier SC here. The same lightwave signal (in accuracy, although it is oscillating in the many modes to the still larger optical frequency band, this lightwave signal is also called the modulation lightwave signal OSmod for convenience) is outputted to the external light modulation section 120. Moreover, the same baseband signaling SBB as

**** is inputted into the external light modulation section 120 from the exterior of the optical sending set 101. The external light modulation section 120 is the inputted modulation lightwave signal OSmod. By carrying out amplitude modulation with the inputted baseband signaling SBB, the double modulation lightwave signal OSdmod shown in (b-5) of drawing 4 is generated and outputted. Although the double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 130, since the component after the optical filter section 130 is the same as the component which corresponds in drawing 1 or drawing 3 as mentioned above, the explanation is omitted.
[0053] (4th operation gestalt) Drawing 6 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 4th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 6 is different at the point further equipped with the optical tee 310, the 2nd photoelectricity converter 320, and the wavelength control section 330 as compared with the optical transmitter-receiver shown in drawing 1 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is omitted. In addition, they are the 1st photoelectricity converter 150 and the 1st lightwave signal OS 1 so that the photoelectricity converter 150 shown in drawing 1 and the lightwave signal OS transmitted in an optical fiber 140 may be known with the expedient top [of explanation], and 4th [this] operation gestalt, if drawing 6 is referred to. It expounds on what is called here (refer to drawing 6).
[0054] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 4th operation gestalt hereafter to drawing 1 based on drawing 6 . In drawing 6 , as the 1st operation gestalt explained, a lightwave signal OS is outputted from the optical filter section 130, and is inputted into the optical tee 310. It is the 1st lightwave signal OS 1 about the lightwave signal OS into which the optical tee 310 was inputted. The 2nd lightwave signal OS 2 It dichotomizes and is the 1st lightwave signal OS 1. Outgoing radiation is carried out to an optical fiber 140, and it is the 2nd lightwave signal OS 2. It outputs to the 2nd photoelectricity converter 320. This 1st lightwave signal OS 1 After transmitting an optical fiber 140, it is processed by the 1st photoelectricity converter 150 like explanation with the 1st operation gestalt. The 2nd lightwave signal OS 2 into which the 2nd photoelectricity converter 320 was also inputted It receives, photoelectricity conversion is performed and an electrical signal is outputted. It is the signal Sdet for detection about the following and this electrical signal. It calls.
[0055] The wavelength control section 330 is the signal Sdet for detection which is the time interval defined beforehand and is inputted. The average is detected. And the wavelength control section 330 is the maximum Vmax out of the detected average. It chooses and is the maximum Vmax concerned. To always be detected, the temperature or bias current of the light source 110 is controlled, and the wavelength (optical frequency) of a main carrier MC is controlled. In an optical transmitter-receiver, the oscillation wavelength of the light source 110 and/or the passband of the optical filter section 130 may shift from the oscillation wavelength defined beforehand and/or a passband by secular change or change of ambient temperature. When such a gap arises, it becomes impossible for the optical filter section 130 to extract only the component of a top sideband wave, or the component of a lower side band to accuracy out of each component (a main carrier component and double sideband component) which the double modulation lightwave signal OSdmod contains. However, since according to the optical transmitter-receiver concerning the 4th operation gestalt the wavelength control section 330 carries out the monitor of the lightwave signal OS and is carrying out feedback control of the oscillation wavelength of the light source 110, even if the above gaps arise, this can be amended and this can always extract [the optical filter section 130] only one sideband wave to accuracy.
[0056] (5th operation gestalt) Drawing 7 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 5th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 7 is different at the point further equipped with the 2nd light receiving set 102-2 connected with the optical sending set 101 possible [optical transmission] through the 2nd optical fiber 140-2 in profile as compared with the optical transmitter-receiver shown in drawing 1 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is simplified. In addition, the lightwave signal OS the optical fiber 140 shown in drawing 1 , the optical receiving set 102, and the photoelectricity converter 150 were indicated to be to drawing 1 again in the thing of explanation called for convenience the 1st

optical fiber 140-1, the 1st light receiving set 102-1, and the 1st photoelectricity converter 150-1 with the 5th operation gestalt is the 1st lightwave signal OS 1. It expounds on what is called here. Moreover, the optical sending set 101 shown in drawing 7 is replaced with the optical filter section 130 as compared with the optical sending set 101 shown in drawing 1 , and is different at a point equipped with the optical filter section 710. Furthermore, the 2nd light receiving set 102-2 is equipped with the 2nd photoelectricity converter 150-2. - (f-7) shows typically the spectrum of the signal in important section (a-7) - (f-7) of the optical transmitter-receiver shown in drawing 8 (a-7) and drawing 7 .
[0057] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 5th operation gestalt hereafter to drawing 1 based on drawing 7 and drawing 8 . It is a modulation factor md about the subcarrier SC which is the baseband signaling SBB inputted from the outside of the **** sending set 101, and was inputted from the local oscillation section 170 as the 1st operation gestalt explained the baseband modulation section 180 in the optical sending set 101. Amplitude modulation is carried out and it is the modulation electrical signal Smod. It generates. Now, the current wave form of this baseband signaling SBB is set to I (t). This modulation electrical signal Smod Voltage waveform Vd (t) is expressed with a before type (2) and is outputted to the external light modulation section 120.
[0058] The light source 110 outputs the main carrier MC of optical spectrum as shown in drawing 8 (a-7). In addition, this drawing 8 (a-7) is the same as that of drawing 2 (a-1). The external light modulation section 120 is the modulation electrical signal Smod inputted from the baseband modulation section 180 as the 1st operation gestalt explained. Amplitude modulation of the main carrier MC inputted from the light source 110 is carried out, and the double modulation lightwave signal OSdmod of optical spectrum as shown in drawing 8 (b-1) is generated and outputted. In addition, the optical spectrum of drawing 8 (b-7) is the same as that of the thing of drawing 2 (b-1). Moreover, field strength wave [of this double modulation lightwave signal OSdmod] E (t) is eventually mathematized like a before type (7), as the 1st operation gestalt explained. The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 710. About the inputted double modulation lightwave signal OSdmod, the optical filter section 710 is a band B1, as shown in drawing 8 (b-7). The component and band B-2 of the lower side band contained The passage optical frequency band is set up so that it may divide into the component of a sideband wave when contained, and a main carrier. It is the 1st lightwave signal OS 1 about the component of the lower side band by which the optical filter section 710 was divided. It is the 2nd lightwave signal OS 2 about the component of the sideband wave after carrying out, and carrying out outgoing radiation to the 1st optical fiber 140-1 and being divided, and a main carrier. It carries out and outgoing radiation is carried out to the 2nd optical fiber 140-2.
[0059] Here, the detailed configuration and actuation of the optical filter section 710 are explained based on drawing 8 and drawing 9 . In drawing 9 , the optical filter section 710 contains the optical circulator section 910 which has terminals 1, 2, and 3, and the optical fiber grating section 920. Here, terminals 1, 2, and 3 are connected with the external light modulation section 120, the optical fiber grating section 920, and an optical fiber 140-1. The double modulation lightwave signal OSdmod inputted into the terminal 1 of the external light modulation section 120 to the optical circulator section 910 is outputted only to the optical fiber grating section 920 connected to a terminal 2 as it is. The optical fiber grating section 920 is the band B1 shown in drawing 8 (b-7) among the double modulation lightwave signals OSdmod which are the optical notch filters of a narrow-band and are inputted. It is set up so that only the component contained may be reflected. Therefore, the 1st lightwave signal OS 1 of the above It is reflected, consequently incidence is again carried out to the optical circulator section 910 from a terminal 2, and outgoing radiation is carried out only to the 1st optical fiber 140-1 connected to a terminal 3 as it is. Moreover, since the component of the area outside the reflexogenic zone (band B1 except) is penetrated among the double modulation lightwave signals OSdmod inputted in the optical fiber grating section 920, it is the 2nd lightwave signal OS 2 of the above. Outgoing radiation is carried out to the 2nd optical fiber 140-2. As mentioned above, the optical filter section 710 can realize optical filtering processing of a narrow-band with an easy configuration by combining the optical circulator and optical fiber grating which are the existing optical components.
[0060] This 1st lightwave signal OS 1 Optical spectrum is optical frequency nu-f 0, as shown in drawing 8 (c-7). It is contained in a nearby optical frequency band. This 1st lightwave signal OS 1 Field strength wave EOS 1 (t) is expressed with a degree type (16). Moreover, filing of a degree type (16) obtains a degree type

(17).
[Equation 14]
$$E_{OS1}(t)=\frac{E}{2}J_0(\frac{km_d}{2})\{J_1(k)J_0(\frac{km_d}{2})\cos(\omega-\omega_0)t$$
$$-J_0(k)J_1(\frac{km_d}{2})(\cos(\omega-\omega_0+\omega_1)t+\cos(\omega-\omega_0-\omega_1)t)\}\cdots(16)$$

[Equation 15]
$$E_{OS1}(t)=K\cos(\omega-\omega_0)t(1-m'\cos\omega_1 t)\cdots(17)$$

Here, m' and K are expressed with a before type (10) and (11) in a top type (16). Moreover, the 2nd lightwave signal OS 2 of the above Optical spectrum is to [near optical frequency nu] nu+f 0, as shown in drawing 8 (d-1). It is contained in a nearby optical frequency band. This 2nd lightwave signal OS 2 Wave EOS 2 (t) is expressed with a degree type (18).
[Equation 16]
$$E_{OS2}(t)=\frac{E}{2}\cos(2\pi\nu t)$$
$$+\frac{E}{2}J_1(k)J_0^2(\frac{km_d}{2})\cos(\omega+\omega_0)t$$
$$-\frac{E}{2}J_0(k)J_0(\frac{km_d}{2})J_1(\frac{km_d}{2})2\cos\omega_1 t\cos(\omega+\omega_0)t\cdots(18)$$

Moreover, if a top type (18) is arranged using m' and K, a degree type (19) will be obtained.
[Equation 17]
$$E_{OS2}(t)=\frac{E}{2}\cos(2\pi\nu t)+K\cos(\omega+\omega_0)t(1-m'\cos\omega_1 t)\cdots(19)$$

[0061] As mentioned above, the 1st lightwave signal OS 1 which was explained based on a formula, drawing 8 , etc. And the 2nd lightwave signal OS 2 It is transmitted with the 1st optical fiber 140-1 and the 2nd optical fiber 140-2, and incidence is carried out to the 1st light receiving set 102-1 and the 2nd light receiving set 102-2. By this, they are both the lightwave signals OS 1. And OS2 It is transmitted to a remote place. First, it is the 1st lightwave signal OS 1 with which incidence of the 1st photoelectricity converter 150-1 was carried out in the 1st light receiving set 102-1. It receives, photoelectricity conversion is performed and an electrical signal is outputted. This 1st lightwave signal OS 1 If drawing 8 (c-7) is referred to, it will be optical frequency nu-f 0. It turns out that a subcarrier is equivalent to that by which amplitude modulation was carried out with baseband signaling SBB (=cos2pif1 t). Therefore, current wave form Ipd1 of the electrical signal which the 1st photoelectricity converter 150-1 outputs (t) is expressed with a degree type (20) like a before type (12).
[Equation 18]
$$I_{pd1}(t)=\frac{\eta_1}{2}K^2(1-m'\cos\omega_1 t)^2$$
$$=I_{pd1}(1-2m'\cos\omega_1 t+m'^2\cos^2\omega_1 t)\cdots(20)$$

However, eta 1 It is the conversion efficiency of the 1st photoelectricity converter 150-1, and is Ipd1. It is a direct-current component. A band pass filter etc. is used from the electrical signal which the 1st photoelectricity converter 150-1 outputs so that he can understand, if a top type (20) is referred to, and it is a frequency f1. If only a component is extracted, as it is shown in drawing 8 (e-7), it is the 1st lightwave signal OS 1. The amplitude modulation component which it has, i.e., current wave form [of baseband signaling SBB] I, (t) will be obtained directly. In addition, frequency f1 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only a component. Here, there should be only a frequency band which can acquire this baseband signaling SBB in the 1st photoelectricity converter 150-1.
[0062] Next, it is the 2nd lightwave signal OS 2 with which incidence of the 2nd photoelectricity converter 150-2 was carried out in the 2nd light receiving set 102-2. It receives, photoelectricity conversion is performed and an electrical signal is outputted. This 2nd lightwave signal OS 2 If drawing 8 (f-7) is referred to, it turns out that it is equivalent to that to which single sideband modulation (Single SideBand

Modulation) of the main carrier MC was carried out with the above-mentioned electric modulating signal Smod (signal which carried out amplitude modulation of the subcarrier SC with baseband signaling SBB). Therefore, current wave form Ipd2 of the electrical signal which the 2nd electrical-and-electric-equipment light converter 150-2 outputs (t) is expressed with a degree type (21).
[Equation 19]

$$I_{pd2}(t) = \left(\frac{E}{2}\right)\frac{\eta_2 K}{2}\cos\omega_0 t(1 - m'\cos\omega_1 t)\cdots(21)$$

Here, it is eta 2. It is the conversion efficiency of the 2nd photoelectricity converter 150-2, and is Ipd2. It is a direct-current component. A band pass filter etc. is used from the electrical signal which the 2nd photoelectricity converter 150-2 outputs so that he can understand, if a top type (21) is referred to, and it is a frequency f0. If only a component is extracted, as it is shown in drawing 8 (f-7), it is the 2nd lightwave signal OS 2. The amplitude modulation component f0 which it has, i.e., a frequency, Electric modulating signal Smod of a band Directly and naturally it will be obtained. In addition, frequency f0 It is easily realizable by connecting a band pass filter to the latter part of the photoelectricity converter 150 to extract only the component of a band. Here, in the 2nd photoelectricity converter 150-2, it is this electric modulating signal Smod. There should be only a frequency band obtained.
[0063] As mentioned above, the optical sending set 101 shown in drawing 7 divides into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side the double modulation lightwave signal OSdmod acquired by modulating a main carrier MC doubly by optical filtering, and carries out optical transmission of each. And the 1st and 2nd light receiving set 102-1 and 102-2 are baseband signaling SBB and the electric modulating signal Smod by carrying out photoelectricity conversion of each separately. It can obtain. In this way, a **** transmitter-receiver is the electric modulating signal Smod which carried out amplitude modulation of the subcarrier SC to baseband signaling SBB now using the same light source 110. Optical transmission can be carried out simultaneously.
[0064] In addition, with the 5th operation gestalt, although the optical filter section 710 was carrying out band division at the component of a lower side band, and the component of a top sideband wave and a main carrier, it may carry out band division at the component of a top sideband wave, and the component of a lower side band and a main carrier. Moreover, electric modulating signal Smod shown in drawing 8 (f-7) f0 In the case of a microwave band or a millimeter wave band, it is suitable to carry out a radio transmission. Then, it is the electric modulating signal Smod to the latter part of the 2nd photoelectricity converter 150-2. The antenna (not shown) which can be emitted to space is formed and it is the electric modulating signal Smod. By leading to the antenna concerned, this optical transmitter-receiver and a radio-transmission system are easily connectable.
[0065] Moreover, the 5th operation gestalt is the electric modulating signal Smod outputted from the baseband modulation section 180. When it is a microwave band and a millimeter wave band, it is the electric modulating signal Smod of this RF. Since it was difficult to carry out direct light modulation of the light source 110 when the frequency response characteristic was taken into consideration, the optical sending set 101 had adopted the external light modulation method. However, electric modulating signal Smod outputted from the baseband modulation section 180 If it is below a microwave band in general, it will not be concerned with the above-mentioned frequency response characteristic, but it is the electric modulating signal Smod concerned. The direct drive of the light source 110 can be carried out, and direct modulation of the output luminous intensity of the light source 110 concerned can also be carried out. That is, a direct light modulation method can also be used for a **** transmitter-receiver.
[0066] (6th operation gestalt) Drawing 10 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 6th operation gestalt of this invention. The optical transmitter-receiver shown in drawing 10 is different at the point further equipped with the 2nd light receiving set 102-2 connected with the optical sending set 101 possible [optical transmission] through the 2nd optical fiber 140-2 in profile as compared with the optical transmitter-receiver shown in drawing 3 . Since there is no point of difference among both optical transmitter-receivers in addition to it, the same reference mark is given to a corresponding component, and the explanation is simplified. In addition, the lightwave signal OS the optical fiber 140 shown in drawing 3 , the optical receiving set 102, and the photoelectricity converter 150 were indicated to be to drawing 3 again in the thing of explanation called for convenience the 1st optical fiber 140-1, the 1st light receiving set 102, and the 1st photoelectricity converter 150-1 with the

6th operation gestalt is the 1st lightwave signal OS 1. It expounds on what is called here. Moreover, the optical sending set 101 shown in drawing 10 is replaced with the optical filter section 130 as compared with the optical transmitter-receiver 101 shown in drawing 3 , and is different at a point equipped with the optical filter section 710. Furthermore, the 2nd light receiving set 102-2 is equipped with the 2nd photoelectricity converter 150-2. Moreover, - (f-10) shows typically the spectrum of the signal in important section (a-10) - (f-10) of the optical transmitter-receiver shown in drawing 11 (a-10) and drawing 10 .

[0067] It explains focusing on a point of difference with the optical transmitter-receiver which shows actuation of the optical transmitter-receiver concerning the 6th operation gestalt hereafter to drawing 3 based on drawing 10 , drawing 11 , etc. In the optical sending set 101, the light source 110 outputs the main carrier MC of optical spectrum as shown in drawing 8 (a-7) to the 1st external light modulation section 120-1, as the 2nd operation gestalt explained. Moreover, the local oscillation section 170 outputs the same subcarrier SC as the above-mentioned to the 1st external light modulation section 120-1. Amplitude modulation is carried out by the subcarrier SC into which the inputted main carrier MC was inputted as the 2nd operation gestalt explained, and the 1st external light modulation section 120-1 is the modulation lightwave signal OSmod. It generates and outputs to the 2nd external light modulation section 120-2. This modulation lightwave signal OSmod As shown in drawing 11 (a-10), since it is the same as that of the optical spectrum of drawing 4 (a-3), optical spectrum omits detailed explanation.

[0068] Moreover, as the 2nd operation gestalt explained, baseband signaling SBB is inputted into the 2nd external light modulation section 120-2 from the exterior of the optical sending set 101. Modulation lightwave signal OSmod into which the 2nd external light modulation section 120-2 was also inputted as the 2nd operation gestalt explained Amplitude modulation is carried out with the inputted baseband signaling SBB, and the double modulation lightwave signal OSdmod is generated. As shown in drawing 11 (b-10), since it is the same as that of the optical spectrum of drawing 4 (b-3), the optical spectrum of this double modulation lightwave signal OSdmod omits detailed explanation. The double modulation lightwave signal OSdmod which was explained above is inputted into the optical filter section 710. About the inputted double modulation lightwave signal OSdmod, the optical filter section 710 is a band B1, as shown in drawing 11 (b-10). The component and band B-2 of the lower side band contained The passage optical frequency band is set up so that it may divide into the component of a sideband wave when contained, and a main carrier. It is the 1st lightwave signal OS 1 about the component of the lower side band by which the optical filter section 710 was divided. It is the 2nd lightwave signal OS 2 about the component of the sideband wave after carrying out, and carrying out outgoing radiation to the 1st optical fiber 140-1 and being divided, and a main carrier. It carries out and outgoing radiation is carried out to the 2nd optical fiber 140-2. This 1st lightwave signal OS 1 Optical spectrum is optical frequency nu-f 0, as shown in drawing 11 (c-10). It is contained in a nearby optical frequency band. Moreover, the 2nd lightwave signal OS 2 of the above Optical spectrum is to [near optical frequency nu] nu+f 0, as shown in drawing 11 (d-10). It is contained in a nearby optical frequency band. The 1st lightwave signal OS 1 which was explained above And the 2nd lightwave signal OS 2 As the 5th operation gestalt explained, incidence is carried out to the 1st light receiving set 102-1 and the 2nd light receiving set 102-2. By this, they are both the lightwave signals OS 1. And OS2 It is transmitted to a remote place.

[0069] The 1st light receiving set 102-1 and the 2nd light receiving set 102-2 are the baseband signaling SBB which has spectrum as shown in drawing 11 (e-10), and the electric modulating signal (signal which carried out amplitude modulation of the subcarrier with baseband signaling) Smod which has spectrum as shown in drawing 11 (f-10) by operating like the 5th operation gestalt. It outputs. in addition, drawing 11 (f-10) -- setting -- electric modulating signal Smod Electric modulating signal Smod of drawing 8 (f-7) abbreviation -- it is shown identically. However, electric modulating signal Smod which is the effect of the sideband wave component (refer to hatching section) of a main carrier MC, and is shown in accuracy at drawing 11 (f-10) Electric modulating signal Smod shown in drawing 8 (f-7) A big distortion is produced a little. However, since the modulation approach of the 6th operation gestalt is different from the thing of the 5th operation gestalt, most formulas used with the 5th operation gestalt concerned expound on not being applied with the 6th operation gestalt concerned. As mentioned above, according to the optical sending set shown in drawing 10 , optical filtering divides optical spectrum into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side for the double modulation lightwave signal OSdmod (refer to drawing 11 (b-10)) acquired by modulating a main carrier MC doubly (it being

amplitude modulation with baseband signaling SBB further about the modulation lightwave signal OSmod acquired by carrying out amplitude modulation of the main carrier by the subcarrier), and optical transmission of each is carried out. And the 1st light receiving set and the 2nd light receiving set can acquire baseband signaling SBB (refer to drawing 11 (e-10)) and the electric modulating signal Smod (refer to drawing 11 (f-10)) by carrying out photoelectricity conversion of each individually. In this way, optical transmission of the signal with which the **** transmitter-receiver also carried out amplitude modulation of the subcarrier to baseband signaling now using the same light source 110 is carried out simultaneously.
[0070] In addition, also in the optical transmitter-receiver shown in drawing 10 , the optical filter section 710 may carry out band division at the component of a top sideband wave, and the component of a lower side band and a main carrier. Moreover, the optical transmitter-receiver shown in drawing 10 also forms an antenna (above-mentioned) in the latter part of the 2nd photoelectricity converter 150-2, and is the electric modulating signal Smod. By leading to the antenna concerned, it is easily connectable with a radio-transmission system. [as well as the optical transmitter-receiver which shows drawing 7] Furthermore, in the optical transmitter-receiver shown in drawing 10 , it became irregular using the subcarrier and the 1st external light modulation section 120-1 was modulating the 2nd external light modulation section 120-2 using baseband signaling. However, the 1st external light modulation section 120-1 may carry out amplitude modulation using baseband signaling, and the 2nd external light modulation section 120-2 may carry out amplitude modulation using a subcarrier.
[0071] (7th operation gestalt) Drawing 12 is the block diagram showing the configuration of the optical transmitter-receiver concerning the 7th operation gestalt of this invention. It differs in that the point which the optical sending set 101 replaces with the optical filter section 710, and is equipped with the optical tee 1210, the point that the 1st light receiving set 102-1 is further equipped with the low pass filter section 1220, and the 2nd light receiving set 102-2 are further equipped with the high pass filter section 1230 as compared with the optical transmitter-receiver which shows the optical transmitter-receiver shown in drawing 12 to drawing 10 . Since it is the same as that of the optical transmitter-receiver shown in drawing 10 about the other configuration, about a corresponding configuration, the same reference mark is attached and the explanation is omitted.
[0072] Hereafter, actuation of the optical transmitter-receiver shown in drawing 12 is explained based on drawing 11 , drawing 12 , etc. The 2nd external light modulation section 120-2 generates the same double modulation lightwave signal OSdmod as the 6th operation gestalt (drawing 11 (b-10 reference)), and outputs it to the optical tee 1210. The optical tee 1210 carries out many branching (it dichotomizes in this explanation) of the inputted double modulation lightwave signal OSdmod, and it carries out outgoing radiation to an optical fiber 140-1 and 140-2. On the other hand, the dichotomous double modulation lightwave signal OSdmod reaches, after this, another side is transmitted in an optical fiber 140-1 and 140-2, and incidence is carried out to the 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2. The 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2 carry out photoelectricity conversion, and output the double modulation lightwave signal OSdmod. in addition, the light-receiving current of the 1st photoelectricity converter 150-1 and the 2nd photoelectricity converter 150-2 -- being alike -- naturally the component of baseband signaling SBB (refer to drawing 11 (e-10)) and the component of the electric modulating signal Smod (refer to drawing 11 (f-10)) are contained.
[0073] The electrical signal outputted from the 1st electrical-and-electric-equipment converter 150-1 is inputted into the low pass filter section 1220, and only the part contained in low-pass among the electrical signals concerned passes the filter section 1220 concerned, and is outputted. By this, baseband signaling SBB (refer to drawing 11 (e-10)) can be acquired like the 2nd operation gestalt. On the other hand, the electrical signal outputted from the 2nd electrical-and-electric-equipment light converter 150-2 is inputted into the high pass filter section 1230, and only the part contained among the electrical signals concerned in a quantity region passes the filter section 1230 concerned, and is outputted. Thereby, the electric modulating signal Smod (refer to drawing 11 (f-10)) can be acquired like the 2nd operation gestalt.
[0074] As mentioned above, according to the optical sending set shown in drawing 12 , the double modulation lightwave signal OSdmod which modulated doubly the same main carrier MC as the optical transmitter-receiver shown in drawing 10 is many branched, and optical transmission of each is carried out. And the 1st light receiving set and the 2nd light receiving set are baseband signaling SBB and the electric modulating signal Smod low-pass, after carrying out photoelectricity conversion of each individually, and by

carrying out high region filtering. It can obtain. In this way, a **** transmitter-receiver can also carry out optical transmission of baseband signaling and the electric modulating signal simultaneously using the same light source 110. In addition, the 1st and 2nd light receiving set 102-1 mentioned above and 102-2 were equipped with the 1st and 2nd photoelectricity converter 150-1 from which the frequency band in which photoelectricity conversion is possible differs mutually, and 150-2. However, the 1st and 2nd light receiving set 102-1 and 102-2 may be equipped with the photoelectricity converter which has the large frequency band which is mutually the same, and bundles up the double modulation lightwave signal OSdmod and can carry out photoelectricity conversion. As for the 1st and 2nd light receiving set 102-1 and 102-2, also in this case, baseband signaling SBB and the electric modulating signal Smod can be acquired low-pass and by carrying out high region filtering. In addition, the thing except the 6th operation gestalt having explained may be applied as an optical sending set 101 concerning this operation gestalt.
[0075] (8th operation gestalt) With the optical transmitter-receiver shown in drawing 12 , two kinds of optical receiving sets with which configurations differ mutually were connected again. However, if an optical receiving set is constituted as follows, even if only one kind of optical receiving set is connected to the optical transmitter-receiver, they are baseband signaling SBB and the electric modulating signal Smod. Both can be obtained. Hereafter, such an optical receiving set is explained based on drawing 13 which shows the configuration.
[0076] The optical sending set 101 and one or more optical receiving sets 102 are connected to the optical transmitter-receiver shown in drawing 13 possible [optical transmission] through an optical fiber 140. Since the optical sending set 101 shown in drawing 13 is the same as that of the configuration of the optical sending set 101 shown in drawing 12 , the explanation is omitted. The optical receiving set 102 shown in drawing 13 has the configuration which is different as compared with the optical receiving set 102-1 shown in drawing 12 , or 102-2, and is equipped with the photoelectricity converter 150, a distributor 1310, the low pass filter section 1320, and the high pass filter section 1330.
[0077] The double modulation lightwave signal OSdmod by which outgoing radiation was carried out from the optical sending set 101 is transmitted in each optical fiber 140, and incidence is carried out to the photoelectricity converter 150 of the optical receiving set 102 so that clearly also from ****. The photoelectricity converter 150 has the broadband property which can carry out photoelectricity conversion of low-pass [from] to the high region, carries out photoelectricity conversion of the double modulation lightwave signal OSdmod in package, and outputs the electrical signal acquired by this to a distributor 1310. Probably this electrical signal is allotted by the distributor 1310 (in this explanation, it considers as two distributions). One side of the electrical signal carried out 2 ****s by the distributor 1310 is inputted into the low pass filter section 1320, and only the part contained in low-pass among the electrical signals concerned passes the filter section 1320 concerned, and is outputted. Baseband signaling SBB (refer to drawing 11 (e-10)) is acquired by this.
[0078] Moreover, another side of the electrical signal carried out 2 ****s by the distributor 1310 is inputted into the high pass filter section 1330, and only the part contained among the electrical signals concerned in a quantity region passes the filter section 1330 concerned, and it is outputted. The electric modulating signal Smod (refer to drawing 11 (f-10)) is acquired by this.
[0079] As mentioned above, an optical transmitter-receiver is baseband signaling SBB and the electric modulating signal Smod like [if it has one optical receiving set shown in drawing 13] the optical transmitter-receiver shown in drawing 12 . Both can be obtained. In addition, the optical receiving set 102 of plurality (a graphic display is two sets) is connected to drawing 13 . However, the number of the optical receiving set 102 may be one set according to the construction conditions of an optical transmitter-receiver. In this case, the optical tee 1210 becomes unnecessary and the 2nd external light modulation section 120-2 carries out outgoing radiation of the double modulation lightwave signal OSdmod to an optical fiber 140. Moreover, in the optical transmitter-receiver concerning the 7th and 8th operation gestalten, the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2 were carrying out amplitude modulation with double sideband amplitude modulation so that clearly, if drawing 11 was referred to. However, the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2 may carry out amplitude modulation with single side band amplitude modulation. According to this single side band amplitude modulation, the double modulation lightwave signal OSdmod has the component of a main carrier MC in the main optical frequency nu first. Further, to optical frequency nu, this double modulation lightwave signal OSdmod is a low high frequency or frequency side,

and is optical frequency f0 from the optical frequency nu concerned. It has the component of a top sideband wave or a lower side band in a location. Although such a lightwave signal OSdmod is transmitted in each optical fiber, since it is hard coming for the optical fiber 140 concerned to receive wavelength dispersion effect as compared with the case of double sideband amplitude modulation, more, optical transmission is carried out and it deals in a long distance.
[0080] (9th operation gestalt) Drawing 14 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 9th operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 14 , the optical receiving set 102-1 shown in drawing 12 and 102-2, or the optical receiving set 102 shown in drawing 13 is connectable. The optical sending set 101 shown in drawing 14 is replaced with the optical filter section 130 as compared with the optical sending set 101 shown in drawing 5 , and is different at a point equipped with the optical tee 1210. In order for there to be no point of difference in addition to it, the same reference mark is given to the corresponding component. Moreover, the optical tee 1210 is also explained with reference to drawing 12 etc. Therefore, about actuation of the optical sending set 101 shown in drawing 14, since it is clearer than these, the explanation is simplified.
[0081] Mode locking of the mode locking light source 510 is carried out by the subcarrier SC inputted from the local oscillation section 170, and it carries out multimode oscillation. If frequency spacing of mode locking is set up equally to the frequency of Subcarrier SC, the modulation lightwave signal OSmod (refer to drawing 11 (a-10)) will be outputted to the external light modulation section 120 from the mode locking light source 510. The external light modulation section 120 is the inputted modulation lightwave signal OSmod. And based on the baseband signaling SBB inputted from the outside, the double modulation lightwave signal OSdmod (refer to drawing 11 (b-10)) is generated, and it outputs to the optical tee 1210. The optical tee 1210 carries out outgoing radiation of the inputted double modulation lightwave signal OSdmod to each optical fiber 140, after many branching. In addition, also in the optical transmitter-receiver shown in drawing 14, that at least one optical receiving set 102 should just be connected, it becomes unnecessary [the optical tee 1210] and the external light modulation section 120 carries out outgoing radiation of the double modulation lightwave signal OSdmod to an optical fiber 140 at one set of the case.
[0082] (10th operation gestalt) Drawing 15 is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 10th operation gestalt of this invention. In addition, although the optical receiving set is not illustrated to drawing 15, the optical receiving set 102-1 shown in drawing 12 and 102-2, or the optical receiving set 102 shown in drawing 13 is connectable. The optical sending set 101 shown in drawing 15 is equipped with the 1st light source 1510-1, the 2nd light source 1510-2, the external light modulation section 120, the optical multiplexing section 1520, and the optical tee 1210. In addition, in the optical sending set 101 of drawing 15, about the thing equivalent to the component of the optical sending set of drawing 14, the same reference mark is attached and suppose that the explanation is simplified. - (d-15) shows typically the spectrum of the signal in important section (a-15) - (d-15) of the optical feeder shown in drawing 16 (a-15) and drawing 15.
[0083] Hereafter, actuation of the optical transmitter-receiver concerning the 10th operation gestalt is explained based on drawing 15 and drawing 16. Setting to the optical sending set 101, the 1st light source 1510-1 is the 1st nothing modulation light UML 1 of optical frequency nu. It outputs to the external light modulation section 120. This 1st nothing modulation light UML 1 It has optical spectrum as shown in drawing 16 (a-15). Moreover, frequency f1 Baseband signaling SBB is inputted into the external light modulation section 120 from the exterior of the optical sending set 101. It is the 1st nothing modulation light UML 1 inputted as the 2nd operation gestalt explained the external light modulation section 120. Amplitude modulation is carried out with the inputted baseband signaling SBB, and it is the modulation lightwave signal OSmod. It generates. This modulation lightwave signal OSmod As optical spectrum is shown in drawing 16 (b-15), it is the 1st nothing modulation light UML 1 to the main optical frequency nu. About a component, it is optical frequency nu to the optical frequency f1 further. It has the component of a sideband wave in the location (only for **f 1, a graphic display is) of an integral multiple. Such a modulation lightwave signal OSmod It is inputted into the optical multiplexing section 1520.
[0084] It is the 2nd nothing modulation light UML 2 in which the 2nd light source 1510-2 separated only predetermined optical frequency from the above-mentioned optical frequency nu. It outputs to the optical multiplexing section 1520. This predetermined optical frequency is the frequency f0 of the above-mentioned subcarrier SC. It considers as corresponding optical frequency. This 2nd nothing modulation

light UML 2 has optical spectrum as shown in drawing 16 (c-15). The optical multiplexing section 1520 is the inputted modulation lightwave signal OSmod. The 2nd nothing modulation light UML 2 It multiplexs so that those polarization may be put together, and it outputs to the optical tee 1210 as a lightwave signal OS. This lightwave signal OS is the modulation lightwave signal OSmod. The 2nd nothing modulation light UML 2 Since it is only multiplexed, it has optical spectrum as shown in drawing 16 (d-15). It turns out that the optical spectrum of this lightwave signal OS is the same as that of the case where the single side band amplitude modulation explained in the 8th operation gestalt is applied when referring to this drawing 16 (d-15). Therefore, the optical sending set 101 constituted like drawing 15 will also do so the same effectiveness as the case where the single side band amplitude modulation explained in the 8th operation gestalt is applied. Furthermore, with this operation gestalt, optical transmission of baseband signaling SBB and the electric modulating signal Smod can be carried out using two sets (the 1st light source 1510-1 and the 2nd light source 1510-2) only of the light sources, without using the local oscillation section 170 like the 8th operation gestalt. Although this needed to perform electric light conversion twice in the 8th operation gestalt in the 1st external light modulation section 120-1 and the 2nd external light modulation section 120-2, as for the optical sending set 101 of this operation gestalt, electric light conversion is only once performed in the external light modulation section 120. Thus, low loss optical transmission is realizable by lessening the count of electric light conversion. Furthermore, the optical sending set 101 of this operation gestalt does not need the electrical part for carrying out amplitude modulation with the electrical signal which should transmit a subcarrier. That is, according to this operation gestalt, it corresponded to the subcarrier band which is a RF relatively, and it is expensive and the difficult electrical part of processing becomes unnecessary. In connection with this, it becomes possible to constitute an optical transmitter-receiver from low cost simply. Furthermore, the oscillation optical frequency of two sets of the light sources can be easily changed by changing each bias current and ambient temperature. Therefore, electric modulating signal Smod acquired by the optical receiving set side A frequency band can be changed easily. in addition, with the 10th operation gestalt, if drawing 16 is referred to, it understands -- as -- the oscillation optical frequency of the 1st light source 1510-1 -- nu -- it is -- the oscillation optical frequency of the 2nd light source 1510-2 -- nu+f 0 it is -- ****** -- it explained. however, the oscillation optical frequency of the 2nd light source 1510-2 -- nu-f 0 you may be .

[0085] if optical transmission of the analog information concerned is put and carried out to Subcarrier SC in each above operation gestalt when baseband signaling is analog information -- the photoelectricity converter 150, 150-1, and 150-2 -- typical -- a lightwave signal -- square -- since it detects, a secondary higher harmonic may be blocked So, in the optical sending set 101 side, the analog / digital conversion of the baseband signaling of analog information are carried out, and optical transmission of the baseband signaling which is the digital information acquired by this is put and carried out to a subcarrier. Optical receiving set 102 grade carries out the digital to analog of such a lightwave signal after photoelectricity conversion. By this, an optical transmitter-receiver can transmit now the quality information which does not receive harmonic interference.

[0086] Moreover, in the optical transmitter-receiver concerning each operation gestalt, it had become the configuration that baseband signaling was inputted from the outside. However, this baseband signaling is beforehand put on the subcarrier of an intermediate frequency using the predetermined modulation technique (amplitude modulation, frequency modulation, or phase modulation). And if optical transmission is carried out after putting the signal which modulates the subcarrier of an intermediate frequency and is acquired on the subcarrier SC outputted from the local oscillation section 170, in the optical receiving set of each operation gestalt, the subcarrier of an intermediate frequency and the signal which modulated Subcarrier SC now can be acquired, and the optical transmission by the modulation technique will become possible. In addition, the above-mentioned intermediate frequency is the frequency f0 of Subcarrier SC. Although limited to a low frequency, for this, the component of the subcarrier of an intermediate frequency is nu**f 0. If not contained in between, it is because it is difficult to carry out photoelectricity conversion and filtering to accuracy. Moreover, in the optical transmitter-receiver concerning each operation gestalt, two or more subcarriers of the intermediate frequency from which a frequency differs mutually are prepared, different baseband signaling can be put on the subcarrier of an intermediate frequency different, respectively, and optical transmission of these can be collectively carried out by adopting frequency-division multiplex further with it.

[0087] Moreover, it also becomes possible to carry out multiplex [of the mutually different baseband

signaling by adopting Time-Division-Multiplexing connection or code division multiple access] to the subcarrier of the intermediate frequency of one wave, and to transmit it to the optical transmitter-receiver concerning each operation gestalt. Furthermore, by using together Frequency-Division-Multiplexing connection, and Time-Division-Multiplexing connection or code division multiple access, more, multiplex [of much information] can be carried out and it can be transmitted. As mentioned above, the electric modulating signal which modulated the subcarrier by the baseband signaling and this which should transmit these after photoelectricity conversion can be simultaneously acquired by dividing optical spectrum into the component of the component of one sideband wave, a main carrier, and the sideband wave of another side, and carrying out optical transmission of the lightwave signal by which amplitude modulation was carried out to the duplex to it by optical filtering, respectively. If this electric modulating signal is a microwave band and a millimeter wave band, it is suitable to carry out a radio transmission. Therefore, according to the **** transmitter-receiver, the system which united the wire net by the optical fiber and the radio-transmission system using an electric modulating signal (RF signals, such as a microwave band and a millimeter wave band) can be built. And in an optical sending set, only one becomes advantageous in respect of construction of an optical transmitter-receiver, the cost of maintenance, etc. not using the light source.

[0088] Moreover, when the lightwave signal of 1.5-micrometer band with the smallest transmission loss is made to transmit to the single mode fiber of 1.3-micrometer band currently generally used, with the lightwave signal to which amplitude modulation of usual was carried out by the signal of a RF like a millimeter wave band, dissipation of the modulation component by distribution arises in several km, but in a **** transmitter-receiver, in order to receive the lightwave signal which has only the component of one sideband wave and by which amplitude modulation was carried out, it also has the description of not being influenced of distribution. Moreover, it is a light amplifier (EDFA;Erbium DopedFiber Amplifier) by using the lightwave signal of 1.5-micrometer band. Since it can also be used, an improvement of light-receiving sensibility is also possible.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, the 2nd light transmitter-receiver (refer to drawing 18) is well used, in order to transmit the baseband signaling SBB of digital information with a cable. On the other hand, it is examined that the 1st light transmitter-receiver (refer to drawing 17) is applied to a radio communications system. Thus, since applications differ mutually, the 1st and 2nd light transmitter-receiver is examined as a separate system, and the optical transmitter-receiver which carries out optical transmission of both baseband signaling and the electrical signal of a RF simultaneously was not examined so much. However, if a wavelength multiplexing technique is used, this optical transmitter-receiver can be built. That is, in a transmitting side, wavelength multiplexing of the lightwave signal outputted from the light source 110 of drawing 18 and the lightwave signal outputted from the external light modulation section 120 of drawing 17 is carried out. After the wavelength multiple signal acquired by this is transmitted in the inside of an optical fiber 140 and dissociating by the optical receiving side, photoelectricity conversion is carried out separately and, as for a receiving side, both signals are simultaneously acquired by this. However, since the transmitting side needed two or more light sources 110 from which oscillation wavelength differs mutually in order to have to separate the lightwave signal by which wavelength multiplexing was carried out to accuracy by the optical receiving side, the optical transmitter-receiver which applied the wavelength multiplexing technique had the trouble of requiring considerable cost in construction of the optical transmitter-receiver concerned.
[0009] In addition, the optical transmitter-receiver with which the subcarrier multiplex optical transmission method was applied is indicated by U.S. Pat. No. 5,596,436, and there is a part which resembles apparently some optical transmitter-receivers indicated to this application in it. However, in the optical transmitter-receiver concerning this United States patent, first, each baseband signaling is modulated for each subcarrier, and each electric modulating signal is generated by each mixer. By the combiner 40, a multiplexed signal multiplexes each electric modulating signal, and is generated. The external optical modulator 46 is this multiplexed signal, and is modulating a light from laser 44 non-become irregular. The optical sending set concerning such an above-mentioned United States patent is different from the optical sending set 101 of this application in respect of a configuration. That is, although the subcarrier used in the optical sending set 101 of this application is one wave, two or more subcarriers are used for the optical sending set concerning the above-mentioned United States patent. Therefore, the spectrum of the lightwave signal by which outgoing radiation is carried out from both optical sending sets is mutually different, and in the lightwave signal concerning the above-mentioned United States patent, although the component of a main carrier and the component of each subcarrier approach mutually on an optical frequency shaft, in the lightwave signal OS concerning this application (after-mentioned), the component of a main carrier and the component of a double sideband do not approach. By this, easy and the remarkable technical effectiveness that it can take out to accuracy also do the component of baseband signaling SBB so as compared with what the optical receiving set concerning this application requires for the above-mentioned United States patent.
[0010] So, the object of this invention is the optical transmitter-receiver which can carry out optical transmission of the electric RF signal, and is offering an optical transmitter-receiver with the small magnitude with the easy and manufacture moreover. Moreover, other objects of this invention are offering the optical transmitter-receiver which can carry out optical transmission of both baseband signaling and the RF signal simultaneously using the same light source.

[Translation done.]

DESCRIPTION OF DRAWINGS

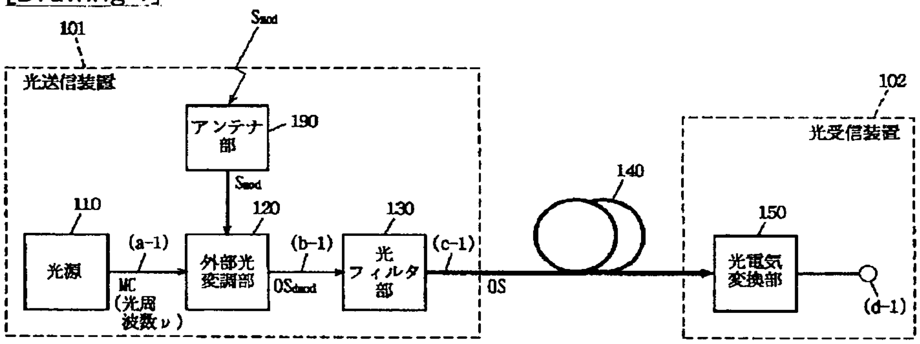
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 1st operation gestalt of this invention.
[Drawing 2] The spectrum of the signal in important section (a-1) - (d-1) of the optical transmitter-receiver shown in drawing 1 is shown typically.
[Drawing 3] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 2nd operation gestalt of this invention.
[Drawing 4] The spectrum of the signal in important section (a-3) - (b-3) of the optical transmitter-receiver shown in drawing 3 is shown typically.
[Drawing 5] It is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 3rd operation gestalt of this invention.
[Drawing 6] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 4th operation gestalt of this invention.
[Drawing 7] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 5th operation gestalt of this invention.
[Drawing 8] The spectrum of the signal in important section (a-7) - (f-7) of the optical transmitter-receiver shown in drawing 7 is shown typically.
[Drawing 9] It is the block diagram showing the detailed configuration of the optical filter section 710.
[Drawing 10] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 6th operation gestalt of this invention.
[Drawing 11] The spectrum of the signal in important section (a-10) - (f-10) of the optical transmitter-receiver shown in drawing 10 is shown typically.
[Drawing 12] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 7th operation gestalt of this invention.
[Drawing 13] It is the block diagram showing the configuration of the optical transmitter-receiver concerning the 8th operation gestalt of this invention.
[Drawing 14] It is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 9th operation gestalt of this invention.
[Drawing 15] It is the block diagram showing the configuration of only an optical sending set about the optical transmitter-receiver concerning the 10th operation gestalt of this invention.
[Drawing 16] The spectrum of the signal in important section (a-15) - (d-15) of the optical sending set shown in drawing 15 is shown typically.
[Drawing 17] It is the block diagram showing the configuration of the 1st light transmitter-receiver used conventionally.
[Drawing 18] It is the block diagram showing the configuration of the 2nd light transmitter-receiver used conventionally.
[Description of Notations]
101 -- Optical sending set
110 -- Light source
120 -- External light modulation section
130,710 -- Optical filter section

120-1 -- The 1st external light modulation section
120-2 -- The 2nd external light modulation section
510 -- Mode locking light source
170 -- Local oscillation section
180 -- Baseband modulation section
190 -- Antenna section
102 -- Optical receiving set
150 -- Photoelectricity converter
150-1 -- The 1st photoelectricity converter
150-2 -- The 2nd photoelectricity converter
140 -- Optical fiber

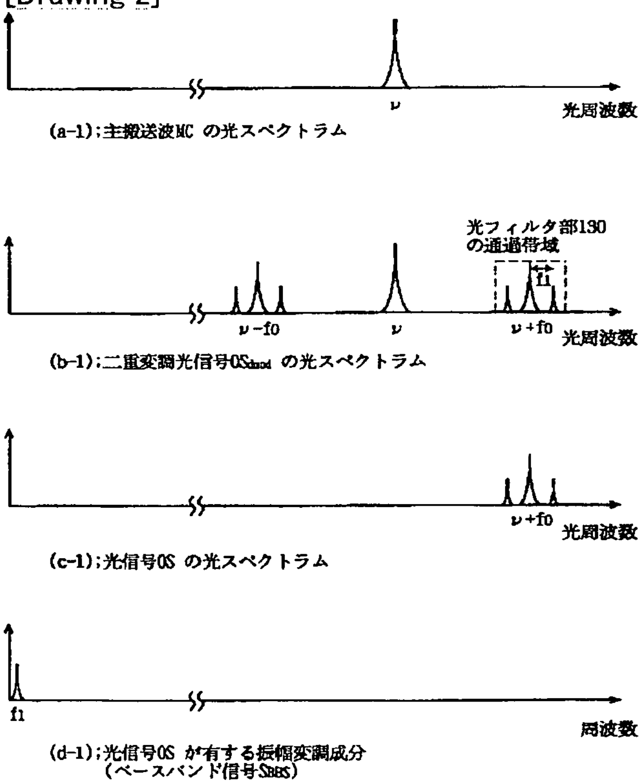
[Translation done.]

DRAWINGS

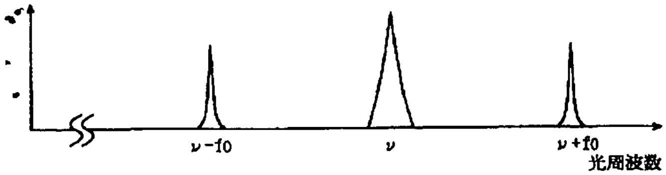
[Drawing 1]



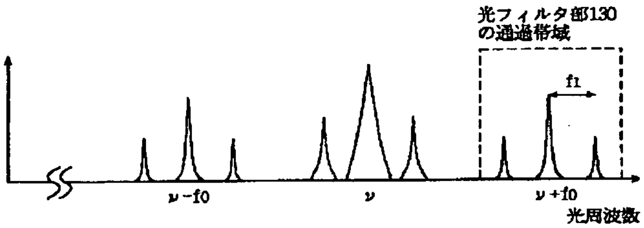
[Drawing 2]



[Drawing 4]

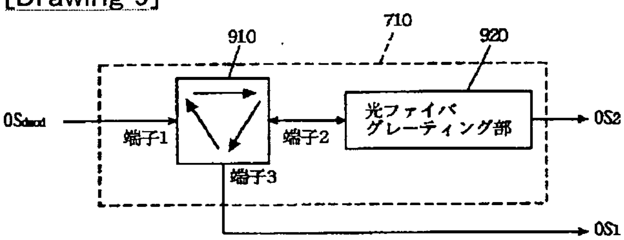


(a-3)：変調光信号OSmod の光スペクトラム

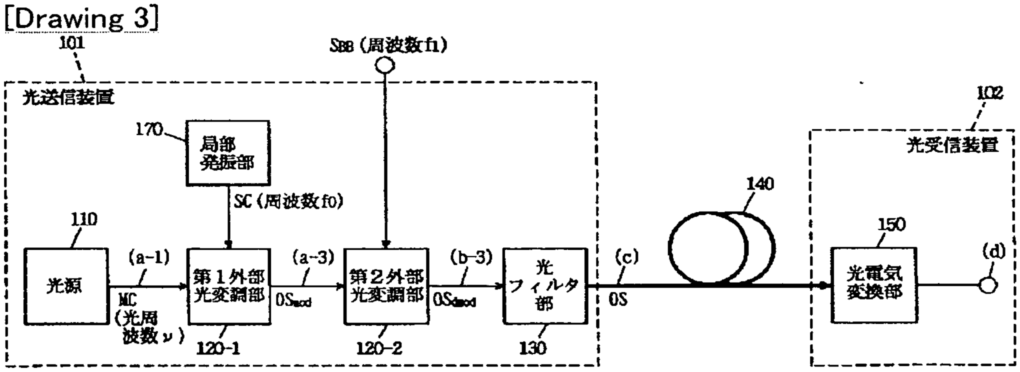


(b-3)：二重変調光信号OSdmod の光スペクトラム

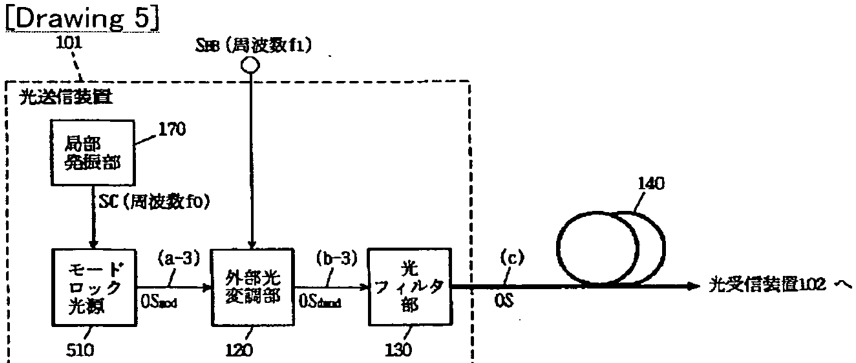
[Drawing 9]



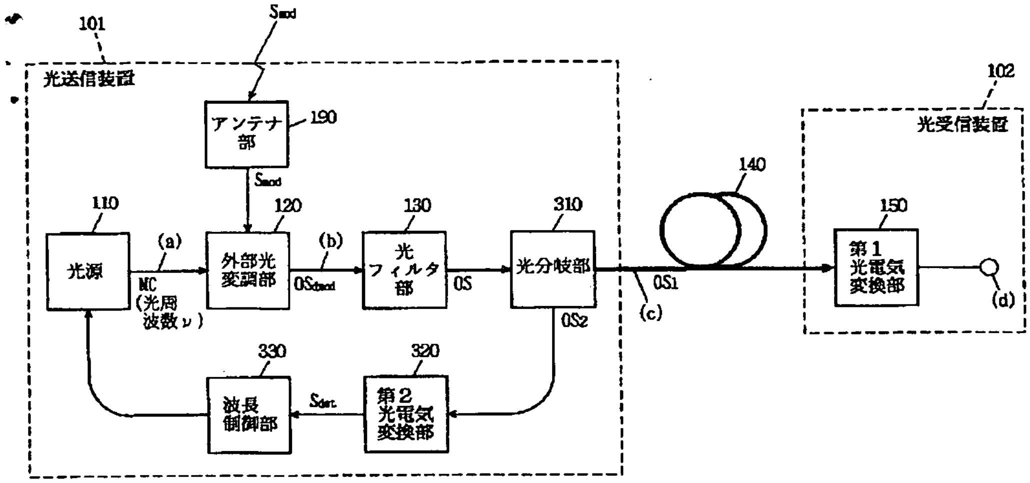
[Drawing 3]



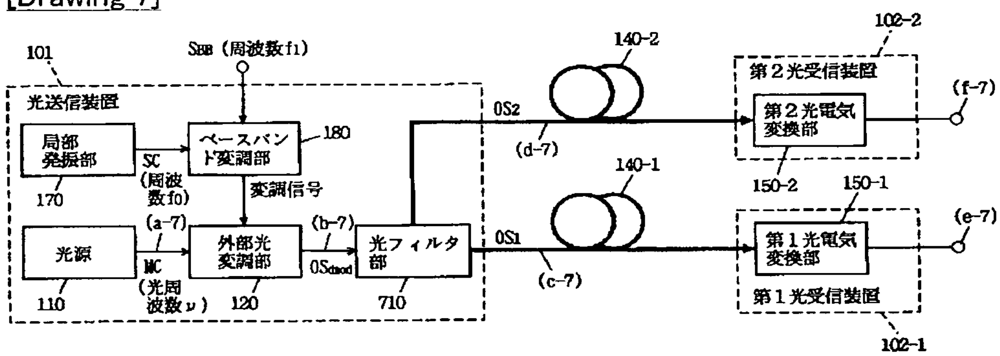
[Drawing 5]



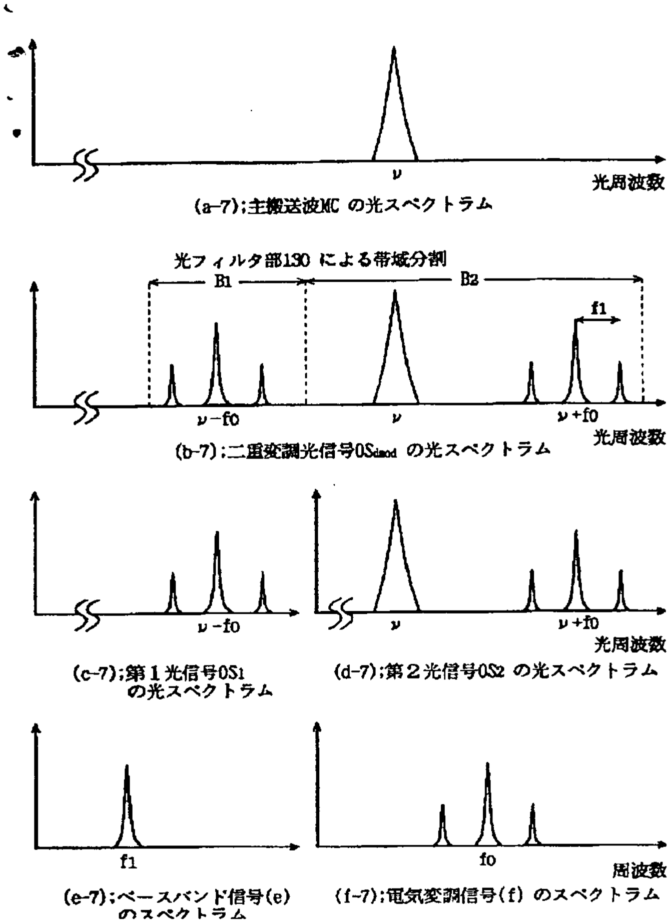
[Drawing 6]



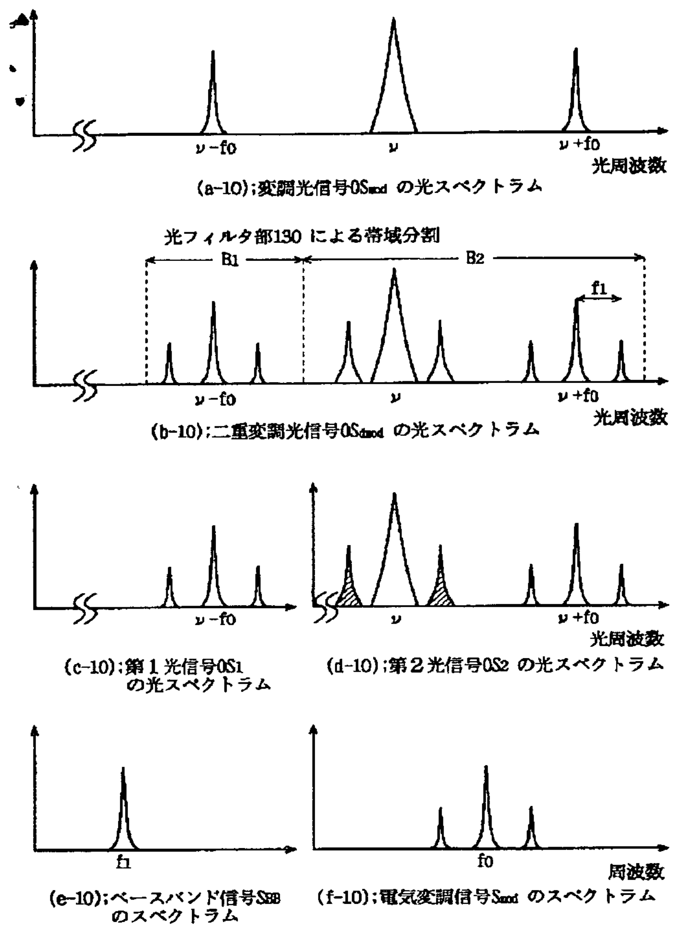
[Drawing 7]



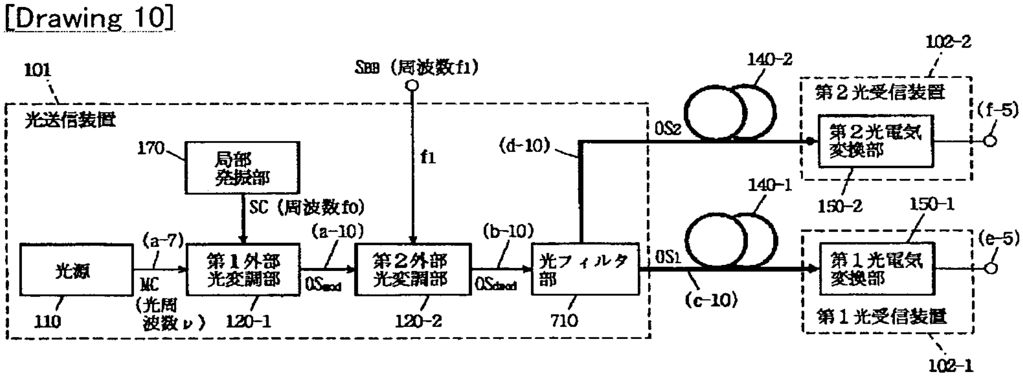
[Drawing 8]


ν
光周波数
(a-7);主搬送波MC の光スペクトラム
光フィルタ部130 による帯域分割
B1
B2
f1
ν−f0
ν
ν+f0
光周波数
(b-7);二重変調光信号OSdmod の光スペクトラム
ν−f0
ν
ν+f0
光周波数
(c-7);第１光信号OS1 の光スペクトラム
(d-7);第２光信号OS2 の光スペクトラム
f1
f0
周波数
(e-7);ベースバンド信号(e) のスペクトラム
(f-7);電気変調信号(f) のスペクトラム

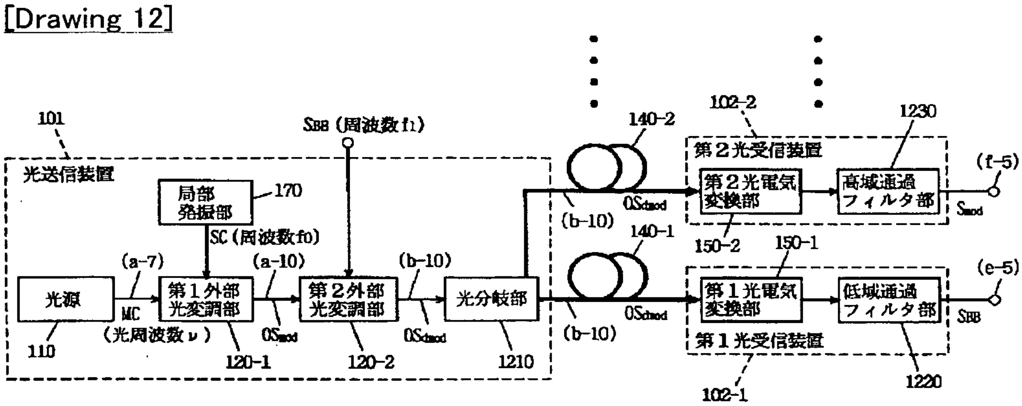
[Drawing 11]



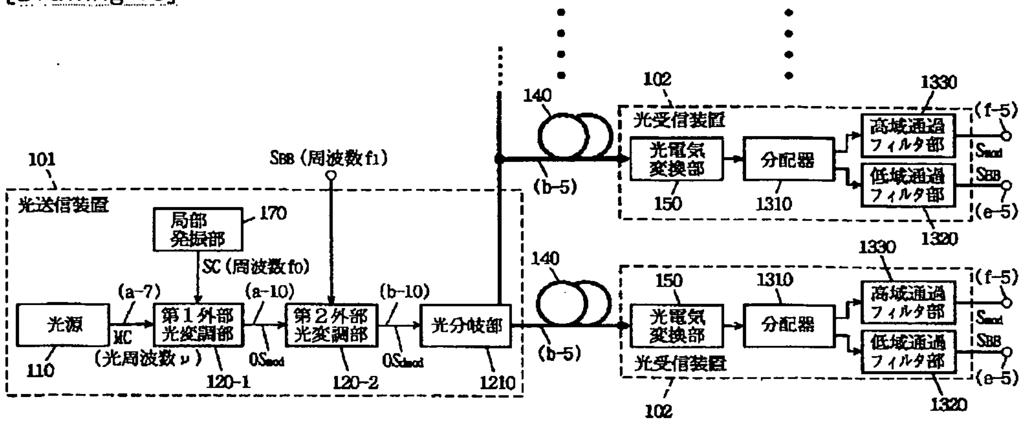
[Drawing 10]



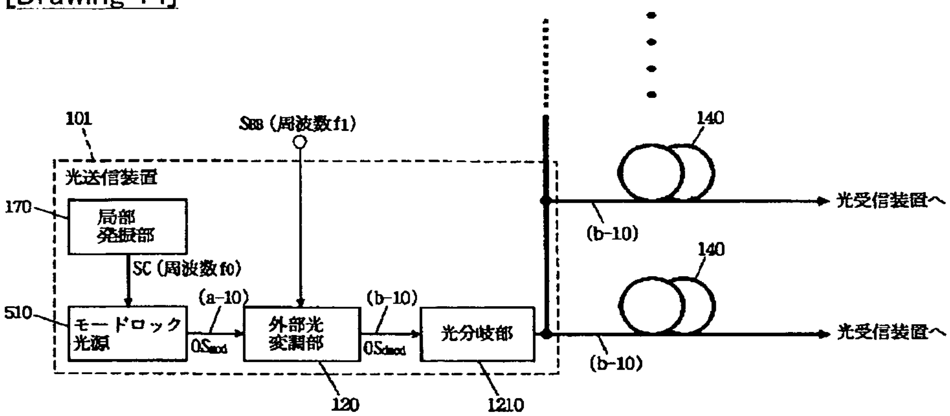
[Drawing 12]



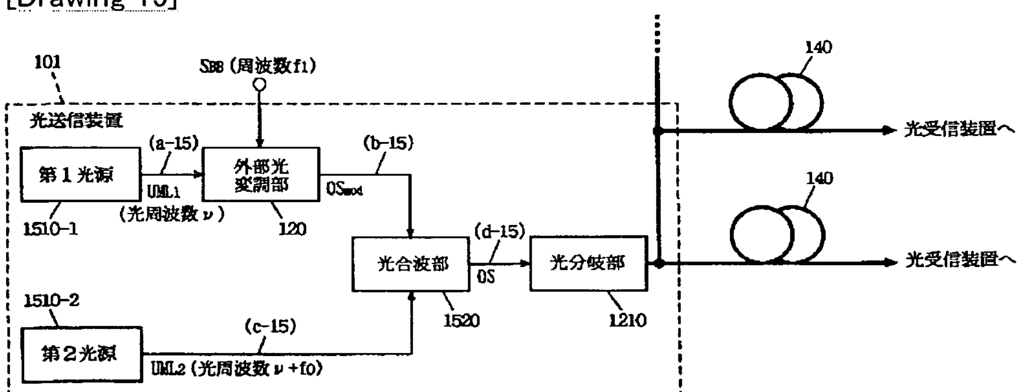
[Drawing 13]



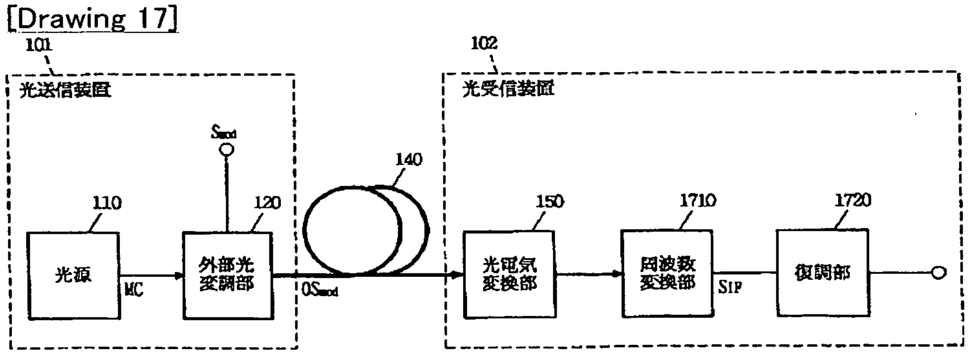
[Drawing 14]



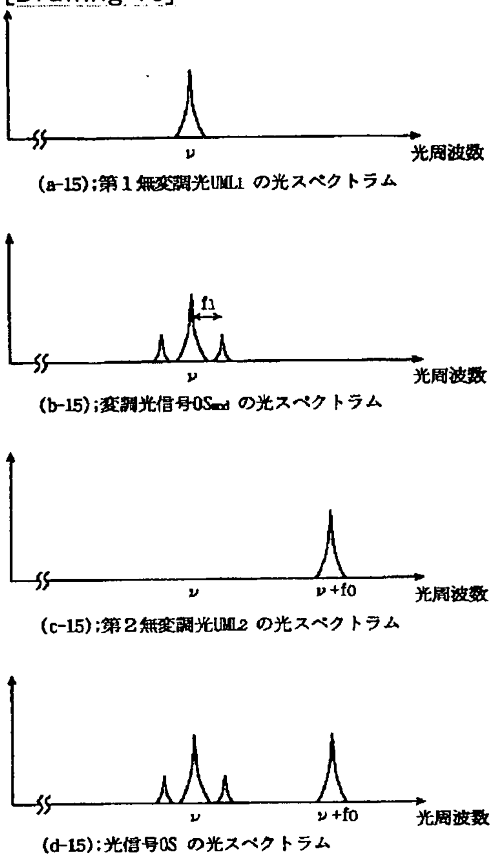
[Drawing 15]



[Drawing 17]



[Drawing 16]



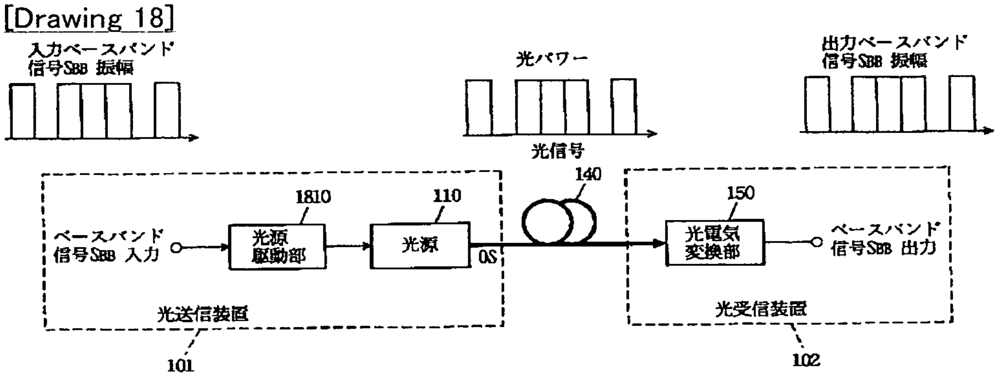
(a-15);第１無変調光UML1 の光スペクトラム

(b-15);変調光信号OSmod の光スペクトラム

(c-15);第２無変調光UML2 の光スペクトラム

(d-15);光信号OS の光スペクトラム

[Drawing 18]



[Translation done.]